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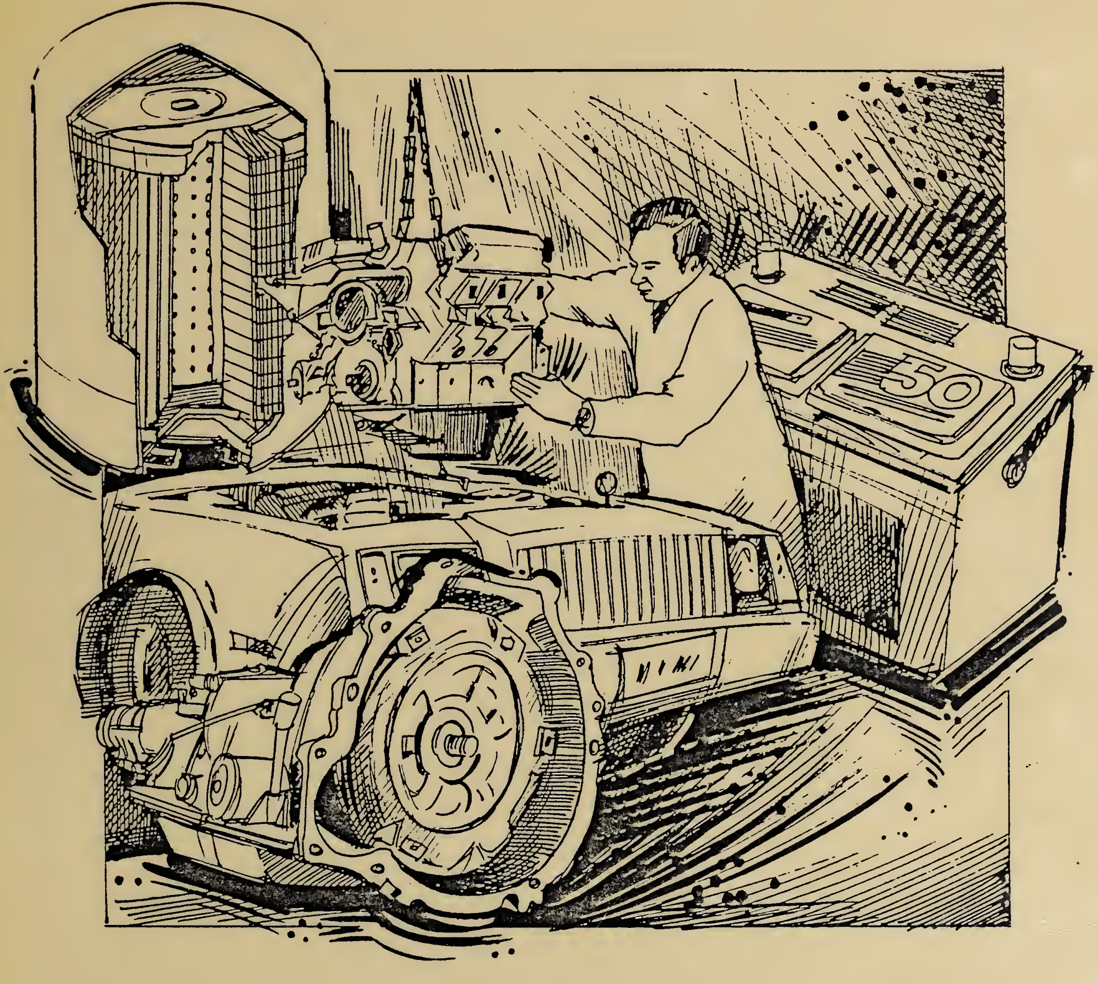

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Automotive Services 16

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Use Appendix 3: "Job Sheet Evaluation Record" to monitor your own performance and have your teacher/supervisor and classmates also evaluate your performance each time you complete a job.

INTRODUCTION

Welcome to the exciting world of automotive service. It is an interesting way to work with your hands, solve mechanical puzzles and earn a living.

Automotive Services 16 lets you explore some of the tasks performed by employees in the automotive industry. Such employees are referred to as: MECHANICS, TECHNICIANS, APPRENTICES, MECHANICS' HELPERS.

Other related jobs available to employees in automotive areas are: PARTSPEOPLE, SALES REPRESENTATIVES, SERVICE ADVISORS, SHOP FOREMEN, SERVICE MANAGERS, WARRANTY REPRESENTATIVES.

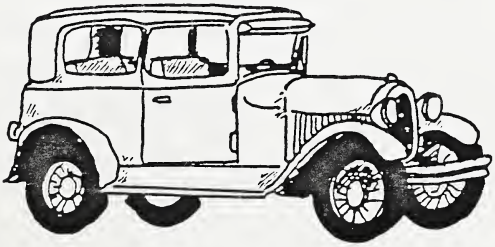
In order to work as an automotive mechanic in Alberta you must be either an apprentice or have achieved journeyman certification as a motor mechanic.

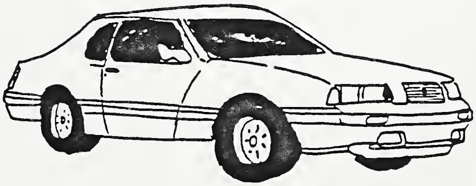
HISTORY AND IMPORTANCE

Ever since invention of the wheel, men and women have needed someone to keep their transportation devices in good working order. Throughout the ages, carriage builders have been some of the most respected tradespeople.

The first motor vehicles were built just 100 years ago. They were built and repaired by blacksmiths. But it didn't take long for car owners to look for trained people to keep their products running.

With the coming of automobile mass production in the 1910's, the need for trained car mechanics increased. The automotive industry has now grown so large that one out of every seven working persons is employed in automotive related industries.





STUDENT ACTIVITIES

1. Discuss the following questions with several adults familiar with automotives. Record the general ideas below.
   - "What changes have occurred in cars over the last forty, or more, years?"

     ____

     ____

     ____

   - "Describe the oldest car you have ever seen."

     ____

     ____

     ____

2. In the space below, provide illustrations of an old car and a modern car. These illustrations can be copied, traced, drawn or cut out. Add the year and automobile make below each illustration.

AUTOMOTIVE SERVICE CAREERS

An automotive mechanic may be required to perform the following tasks in a service station or dealership:

- routine vehicle maintenance
- problem diagnosis and troubleshooting
- emergency fieldwork and repairs
- major component overhauls
- accessory installation
- new car preparation before delivery to the customer
- elementary machine shop work
- oxygen/acetylene welding and cutting
- electric arc welding
- discuss problems with customers.

ENTRY-LEVEL SKILLS

A person starting in automotive service can expect to do any, or all, of the following jobs:

- keep work area clean and organized
- change oil
- pump gas
- change tires
- pick up or deliver vehicles and parts
- empty the garbage cans
- drive customers to work
- set up displays
- perform inventories

In order to do these jobs, entry-level employees should be able to:

- understand and follow instructions
- read parts and service manuals
- read and write work orders
- perform basic mathematical calculations accurately
- talk to the customers in a businesslike manner
- obtain a suitable driver's licence
- drive vehicles
- complete assigned tasks.

CAREER DESCRIPTIONS

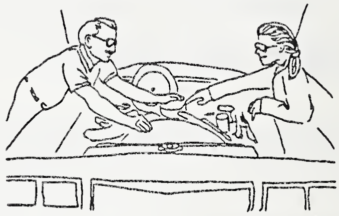
There are many careers available for people with a businesslike attitude, willingness to learn and some basic mechanical skills. This section will introduce the common jobs directly related to automotive service and repair. These jobs include:

- mechanic's helper
- apprentice motor mechanics
- journeyman motor mechanics
- speciality mechanics
- shop foreman
- service advisor
- service manager.

Note: Mechanics are often referred to as service technicians.

Mechanic's Helper

These employees may be found in large shops in areas such as the wash or lubrication bay. These people perform entry-level tasks such as washing cars and cleaning up the shop. The job does not require any formal training and skills may be learned on-the-job. A mechanic's helper may be offered an apprenticeship if appropriate skills and attitudes are demonstrated consistently.



Apprentice Motor Mechanic

Motor mechanic is the legal term used to describe automotive mechanics in Alberta. An apprentice is someone who is enrolled in the provincial trade training program. Apprentices are assigned tasks according to their past experience and training level.

Journeyman Motor Mechanic

This job involves all forms of automotive mechanical maintenance and repair and could include anything from changing light bulbs to overhauling transmissions. Tasks are performed on cars and light duty trucks.

Speciality Mechanic

A motor mechanic with additional training and experience in one particular type of mechanical work may be employed as a speciality mechanic. Some examples of speciality mechanic job titles include:

- tune-up mechanic
- automatic transmission mechanic
- trim mechanic.

Shop Foreman

Both men and women may be employed as a shop foreman. This position involves the supervision of shop work and advising staff and customers on mechanical problems. The job is usually held by experienced motor mechanics with above average skills and knowledge. The main responsibilities for a shop foreman are ensuring high quality repair work and supervising the shop staff.

Service Advisor

This person may or may not be a journeyman motor mechanic. The job definitely requires general automotive knowledge and public relations skills. The service advisor greets the customer and records on the work order the information required about problems. Often, service advisors are expected to contact the customer and explain the invoice when the vehicle is repaired. Experienced service advisors may also do time and cost estimates on service and parts. As this may involve dealing with upset or concerned customers, it is essential to have a good sense of humour and a controlled temper.

Service Manager

The service manager is responsible for all aspects of the service department operation. Most service managers are experienced motor mechanics who have climbed the career ladder and gained business and staff management skills. This is a well-paid job that involves responsibilities such as:

- hiring and firing staff
- planning staff training

- meeting with customers, government and business officials
- planning and ensuring business growth
- directing staff.

There are many other careers available for people with basic mechanical skills. Related employment outside of automotive services may be found in:

- parts departments or stores
- touring firms
- autobody shops
- car sales and leasing outlets
- heavy equipment repair shops
- industrial repair businesses
- agricultural machinery repair shops.

PHYSICAL REQUIREMENTS

Men and women entering automotive services careers should have:

- good eyesight, hearing and hand skills
- the strength or arms necessary to lift parts, pull and push tools
- the ability to read and understand service manuals
- the ability to write clearly and converse well with customers, supervisors and fellow workers.
- good grooming skills for customer contact
- the cleaning skills necessary to return cars to their owners in a clean and neat condition
- the organizational skills to keep the work area in a safe and sanitary condition.

WAGES

Wages for entry-level employees are close to the minimum wage, but rise quickly as knowledge and skills improve. Most mechanics in dealerships work on a FLAT RATE pay system, a set amount of time for a given task. The more work performed, the more money earned. Other shops pay according to STRAIGHT TIME and the worker is paid on an hourly wage. In both cases, the rate of pay is about the same per hour. Shops in urban areas may pay higher wages than rural shops.

ADVANTAGES AND DISADVANTAGES OF AUTOMOTIVE SERVICE CAREERS

ADVANTAGES

- Automotive service people are in demand. Employment opportunities are available for well-qualified, experienced workers.
- Apprenticeship training is free and you earn while you learn.
- Additional training costs are relatively low.
- It is quite easy to become self-employed and set up your own small shop.
- Skilled, efficient workers can make an above average income.
- Personal vehicle operating costs will be reduced because you will be able to work on your own vehicle.

DISADVANTAGES

- Tools are expensive.
- Automotive service people need ongoing training to maintain success.
- The working conditions may be noisy, dirty, hot and smelly.
- Unless workers are knowledgeable and efficient, they will earn only minimum wages.
- The occupation demands physical strength and endurance.
- Exposure to oils and other petroleum products may cause allergies and/or other reactions.

STUDENT ACTIVITIES

1. Define the following terms:

    - Mechanic: ______________________________
    ____
    - Technician: ______________________________
    ____
    - Service Manager: ______________________________
    ____
    - Diagnosis: ______________________________
    ____

- Maintenance: ____________________

- Troubleshooting: ____________________

- Flat Rate: ____________________

- Straight Time: ____________________

- Apprenticeship: ____________________

- Journeyman: ____________________

2. Brainstorm and list the qualifications required to become a:

   - Mechanic's Helper: ____________________

   - Apprentice: ____________________

   - Licenced Mechanic: ____________________

   - Specialist Mechanic: ____________________

   - Shop Foreman: ____________________

   - Service Manager: ____________________

3. Look in a local newspaper and clip the job advertisements seeking people with automotive-related skills.

   Working in groups of three or four, develop a clippings book. Place job advertisements in appropriate categories for future reference. This reference may be useful when looking for part-time work or for people to interview for various assignments.

4. In which area of the automotives industry would you like to work? Why?

   ____

   ____

   ____

   ____

5. The automotives industry is changing rapidly. What can workers do to keep up to date with the changes in automotive technology?

   ____

   ____

   ____

   ____

6. Visit your school counsellor or an Alberta Career Development Centre and answer the following questions on the Motor Mechanic Apprenticeship Program.

   - How many years of training is required to be a journeyman motor mechanic?

     ____

   - What is the monthly breakdown of a training year?

     ____________ months in an employer's shop

     ____________ months in technical training school.

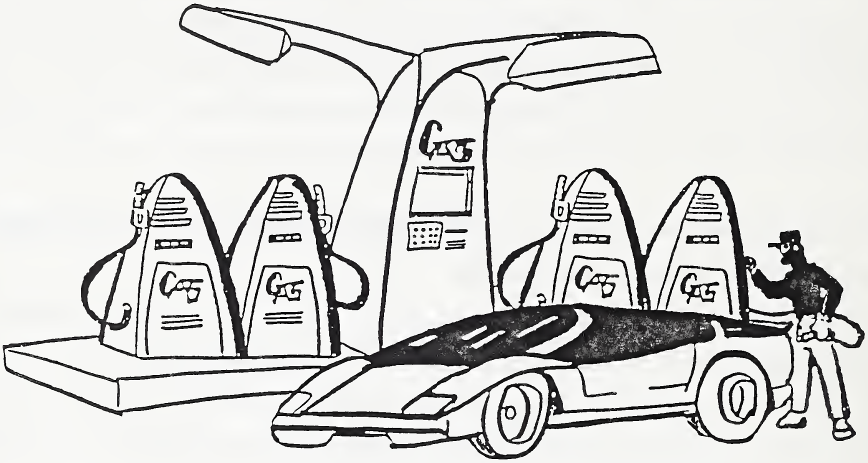
   - What is the wage rate for each of the years of training?

     ____

     ____

- Where is technical training offered?

- What are the three main requirements to get an apprenticeship in motor mechanics?



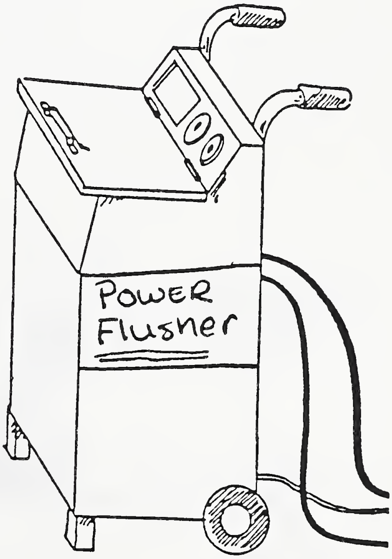
EQUIPMENT AND TOOLS

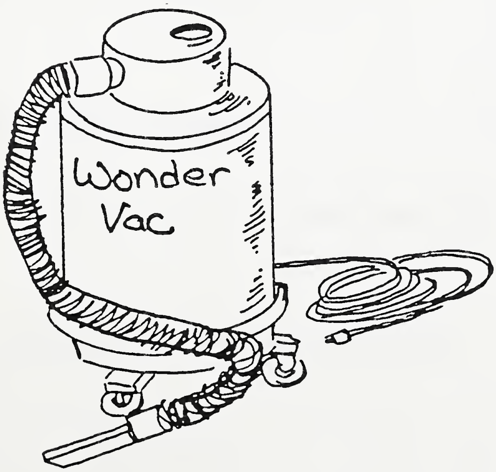
Automotive services workers use a variety of equipment and tools to complete their work. This section will introduce only the common items.

EQUIPMENT

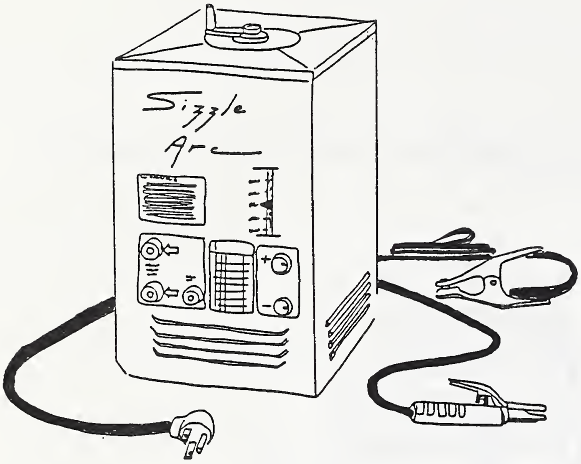
Equipment refers to the power machines used to test, lift and work on vehicles. Common equipment includes:

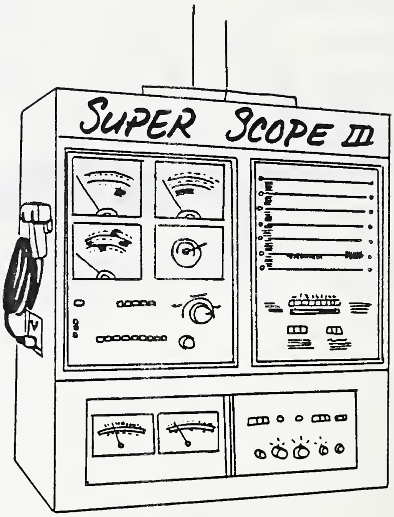
- Arc Welders
- Hoists
- Oscilloscopes
- Tire Changers
- Cooling System Flushing Machines
- Battery Chargers
- Tire Balancers
- Floor Jacks
- Vacuum Cleaners
- Car Wash Pumps.

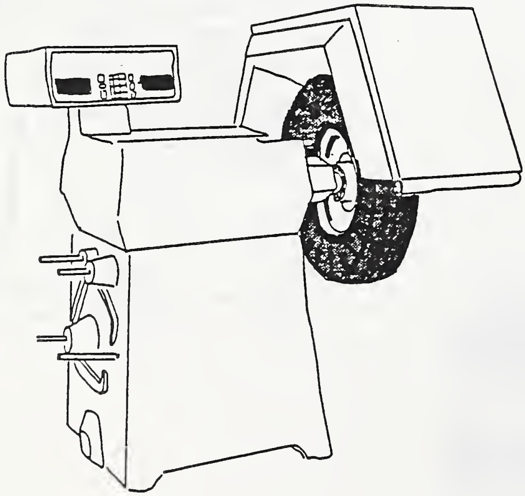


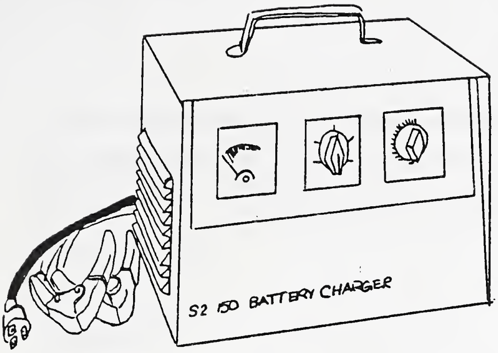


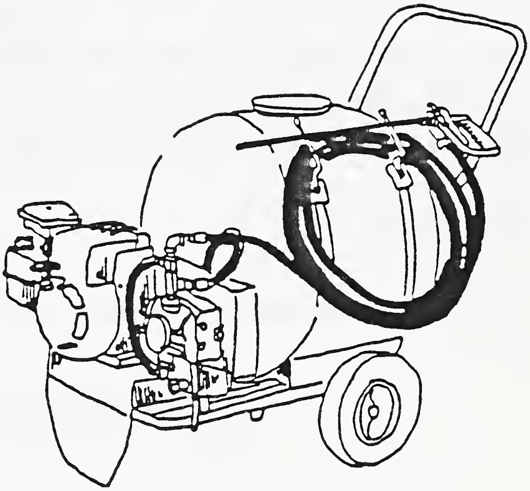
EQUIPMENT

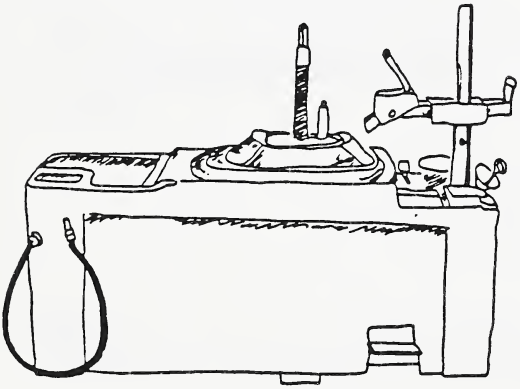












STUDENT ACTIVITIES

1. Using equipment and tool catalogues, identify the items of equipment shown on pages 11 and 12.

2. Write the correct name under each item.

TOOLS

Tools are either hand tools or power tools. Hand tools are manually operated. Power tools are used to speed up tasks, and are operated by compressed air or electricity. Power tools have the additional advantage of reducing user effort. Measuring tools may be either hand or powered.

HAND TOOLS

On the following pages are lists and illustrations of the most common hand tools.

HAND TOOLS

Wrenches

Box End

Open End

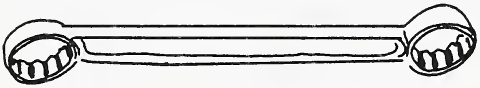
Combination End

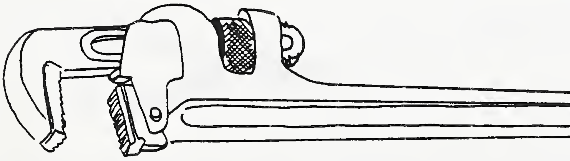
Flex Head

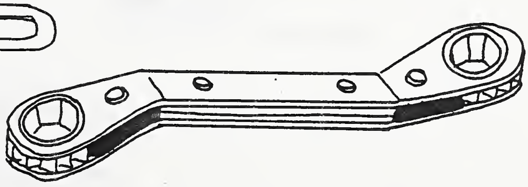
Tubing Wrench

Pipe Wrench

Adjustable End Wrench



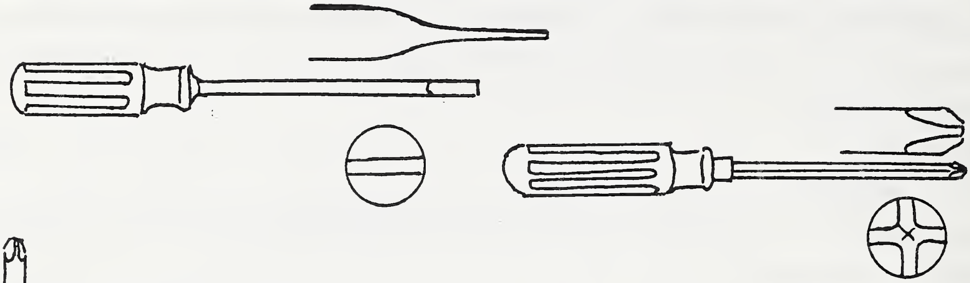


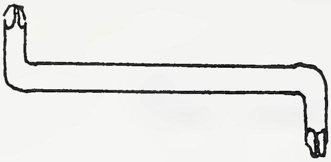


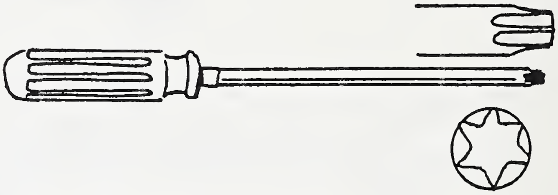
HAND TOOLS

Screwdrivers

Standard
Phillips
Torx
Offset

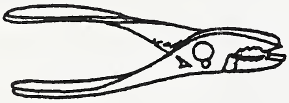


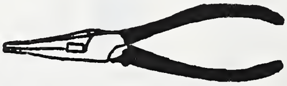


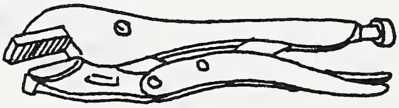


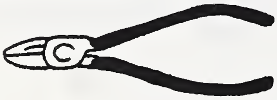
Pliers

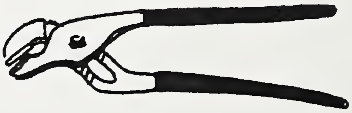
Slip Joint
Needle Nose
Lock Grip
Diagonal Side Cutter
Rib Joint







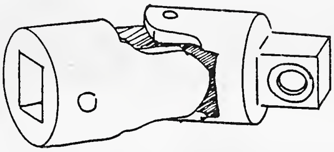


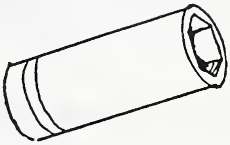


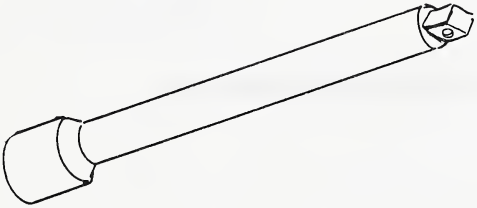
HAND TOOLS

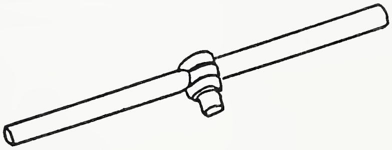
Parts of a Socket Set

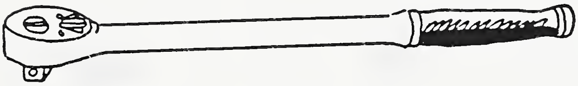
- Flex Handle
- Ratchet
- Universal Joint
- Speed Handle
- Extension
- Standard Socket
- Deep Socket
- Six Point Shallow Socket
- Twelve Point Shallow Socket

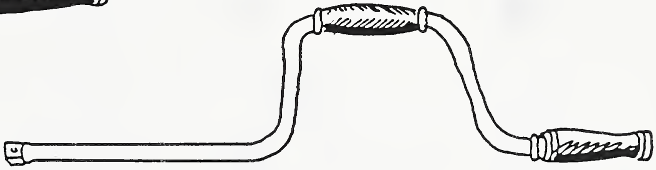


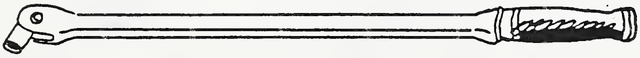


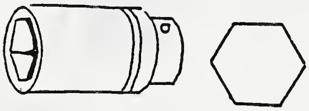


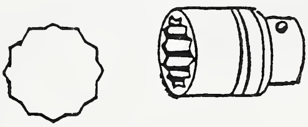








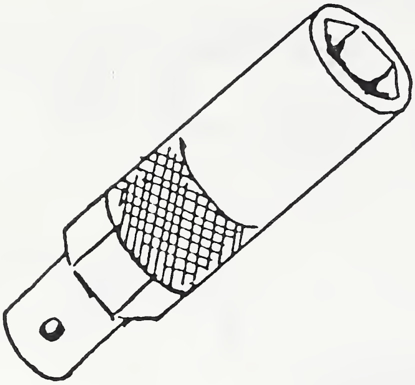


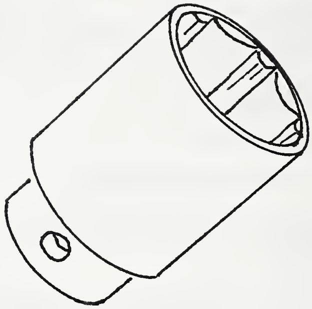


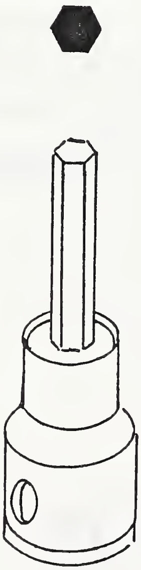
HAND TOOLS

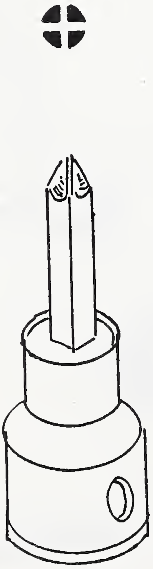
Special Purpose Sockets

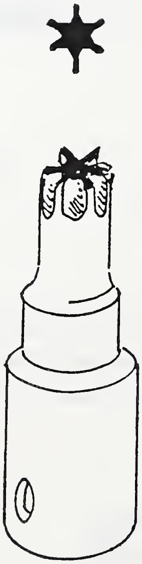
Phillips
Sparkplug
Allen Head
Torx
Shock Absorber
Oil Sender

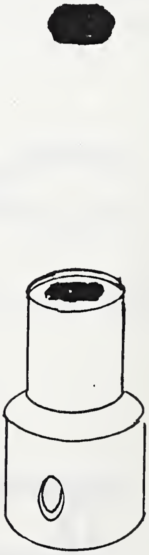








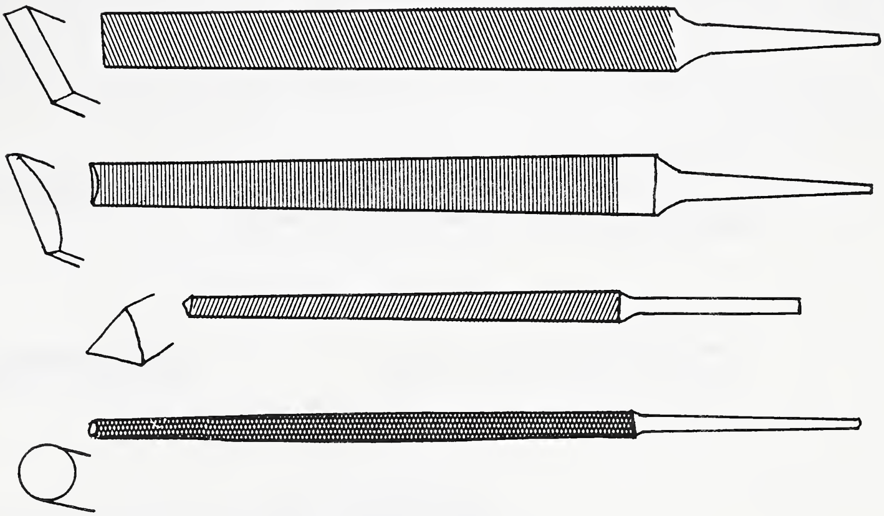




HAND TOOLS

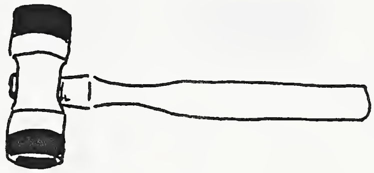
Files

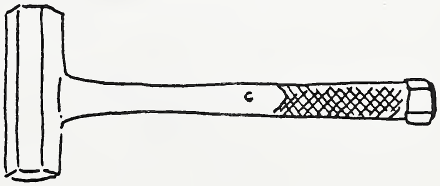
- Flat
- Half Round
- Triangle
- Round



Hammers

- Ball-Peen
- Plastic Tip
- Rubber Mallet
- Dead Blow

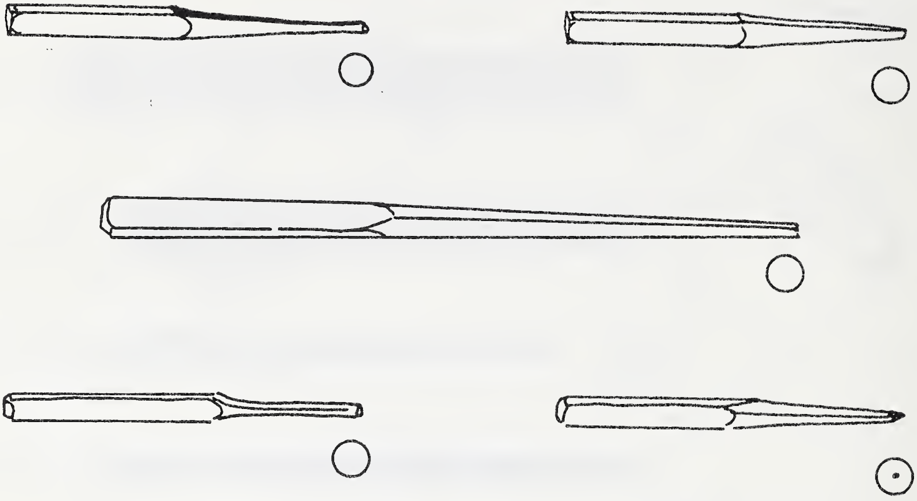




HAND TOOLS

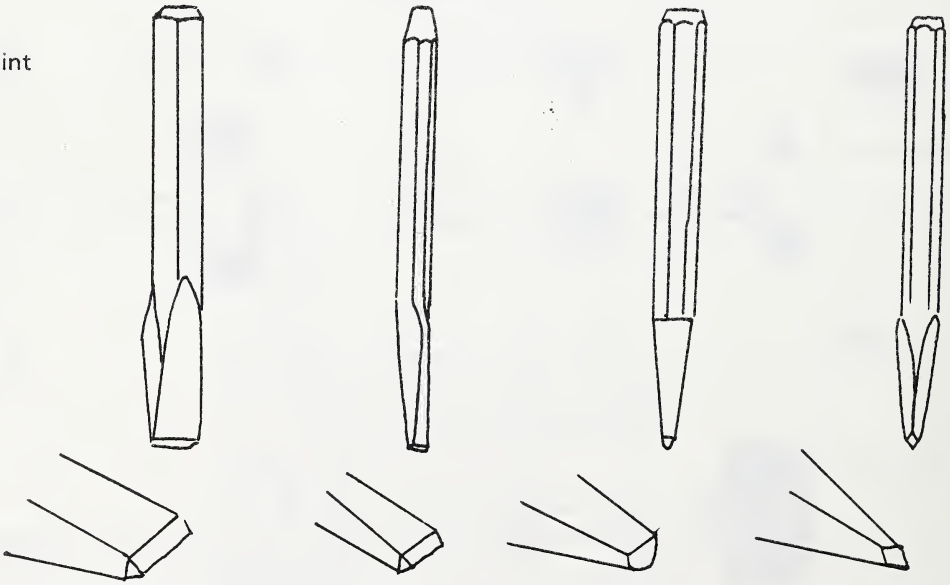
Punches

Pin
Starting
Aligning
Center



Chisels

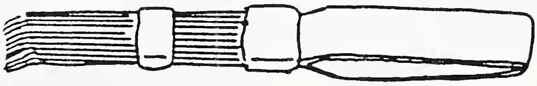
Cold
Cape
Round Nose
Diamond Point

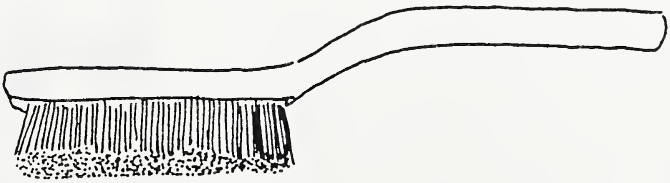


HAND TOOLS

Parts Cleaning Tools

Wire Brush
Carbon Scraper
Parts Cleaning Brush
Gasket Scraper





STUDENT ACTIVITIES

1. Using tool catalogues, identify the hand tools shown on pages 15 to 21.

2. Write the correct name under each item.

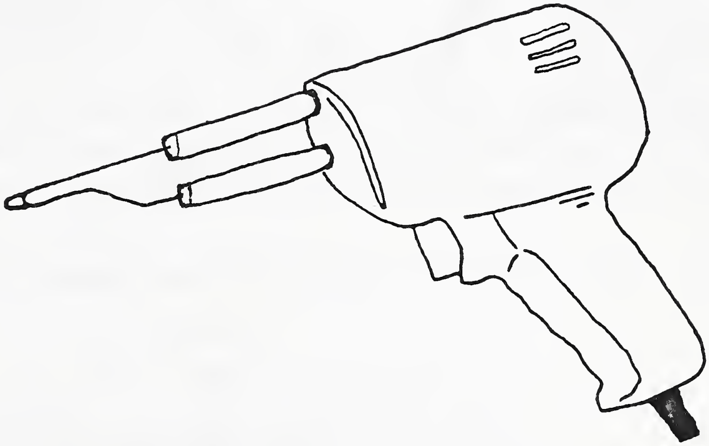
3. What are the advantages and disadvantages of owning a set of automotive hand tools? List them.

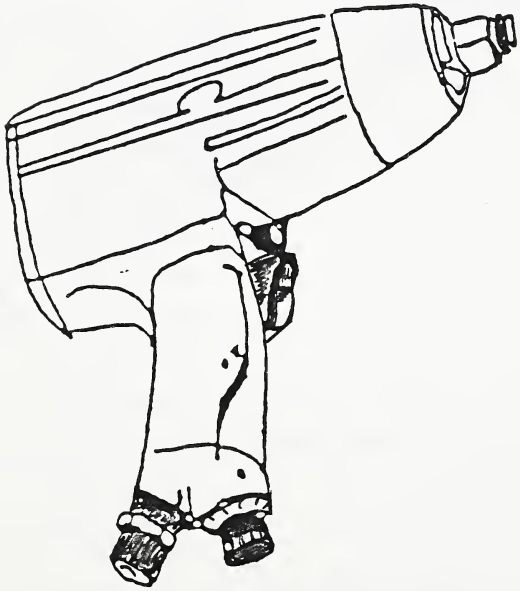
Advantages	Disadvantages

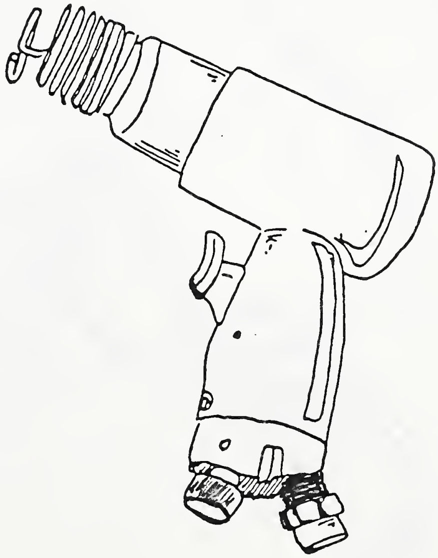
POWER TOOLS

Some examples of power tools include:

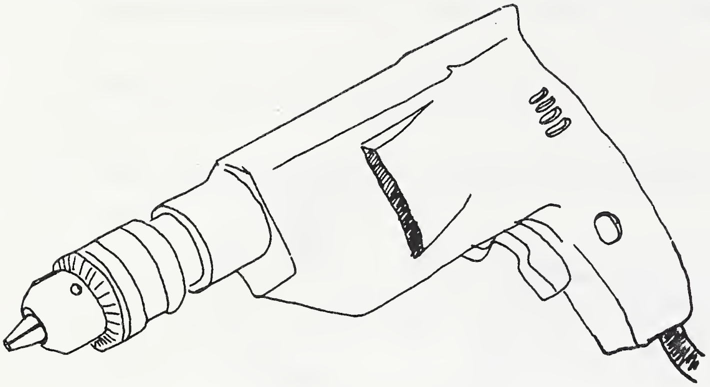
- Electric Drills
- Impact Wrenches
- Air Hammers
- Soldering Guns
- Grinders.

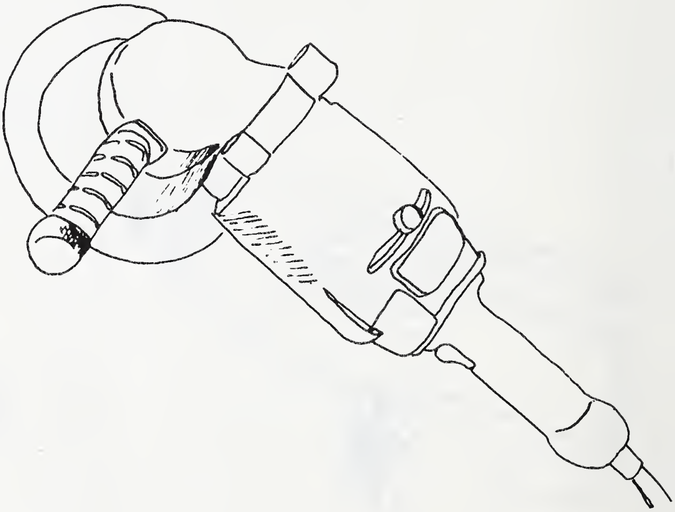


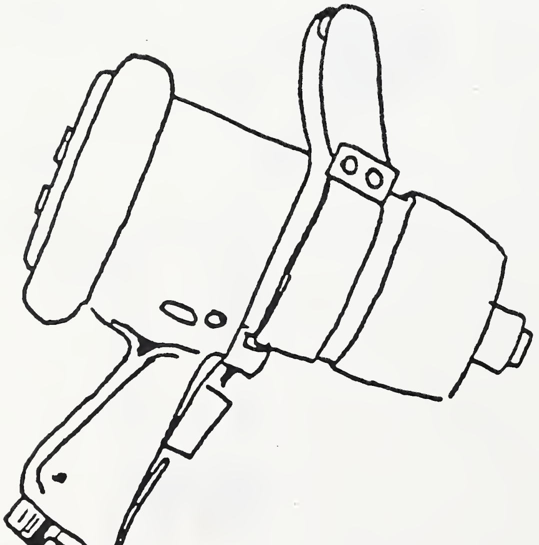




POWER TOOLS







STUDENT ACTIVITIES

1. Using equipment and tool catalogues, identify the power tools.

2. Write the correct name under each item.

MEASUREMENT

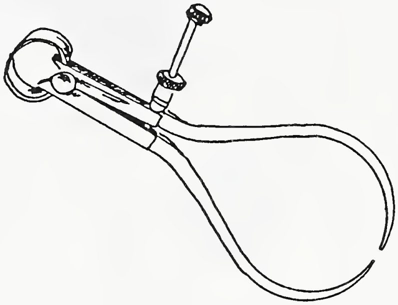
A mechanic is constantly taking measurements of things on vehicles. When repairing a car or replacing components, measurements (e.g., engine compression, cylinder volume, cable length, tire diameter) are used to ensure that repairs and replacements meet manufacturer's specifications.

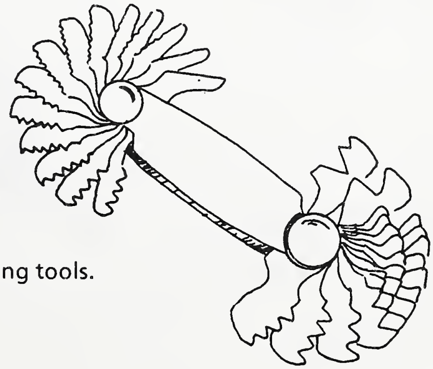
The ability to measure accurately depends upon the correct use of the measuring tools.

MEASURING TOOLS

Auto workers use a variety of measuring tools, including:

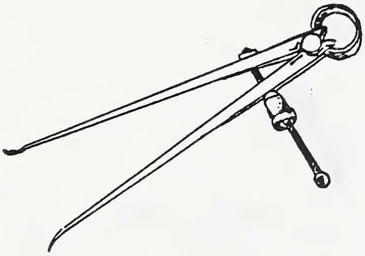
- Ruler
- Inside Calipers
- Outside Calipers
- Outside Micrometer
- Inside Micrometer
- Spark Plug Gauge
- Feeler Gauges
- Dial Indicator
- Hydrometer
- Pitch Gauge
- Cooling System Pressure Tester
- Thermometer
- Tape Measure.

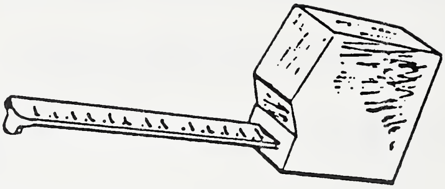


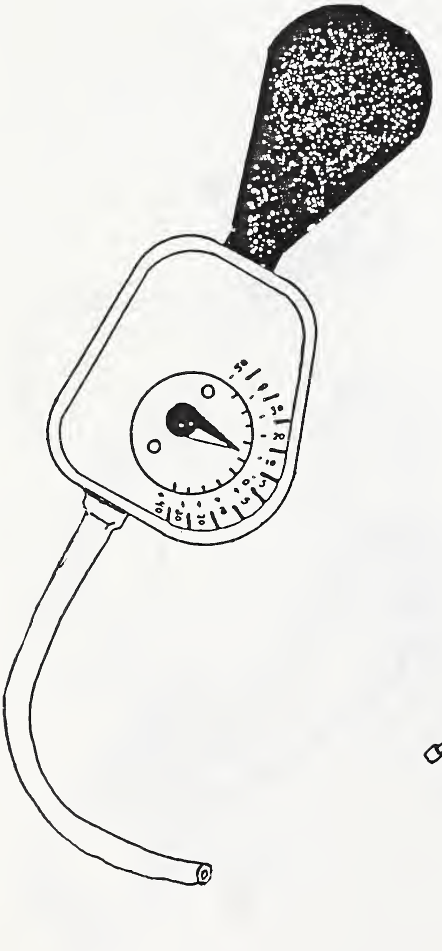


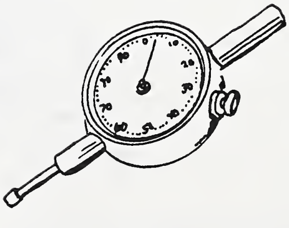
The following illustrations display common measuring tools.

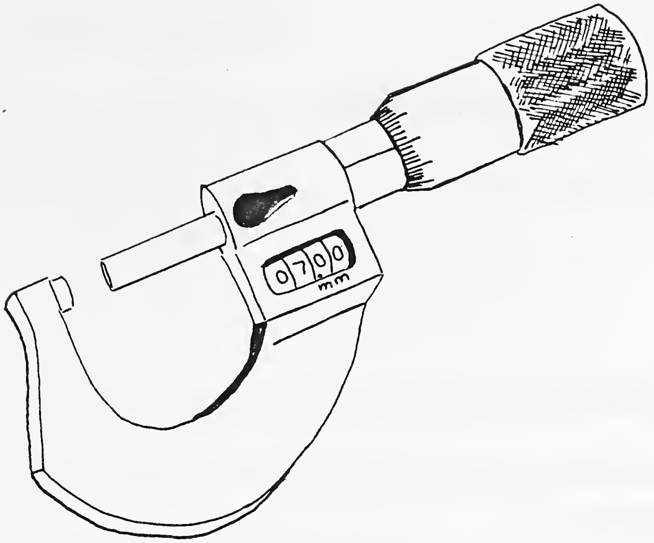
MEASURING TOOLS







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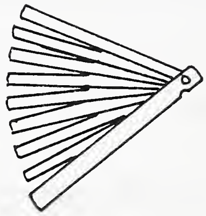
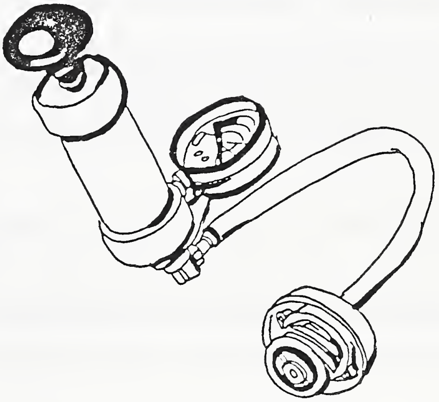
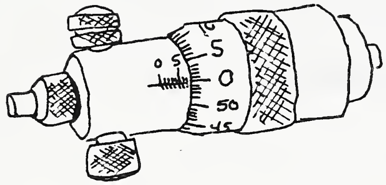
mm



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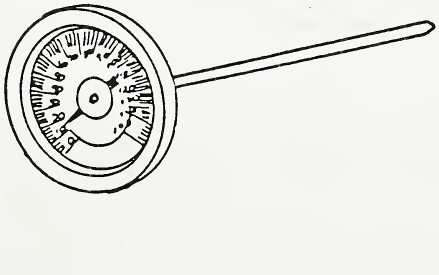


STUDENT ACTIVITIES

1. Using equipment and tool catalogues, identify the measuring tools.

2. Write the correct name of the item below each illustration.

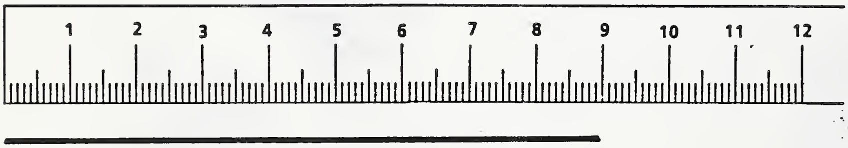
Ruler Use

Rulers are used to measure straight lines across an object's surface.

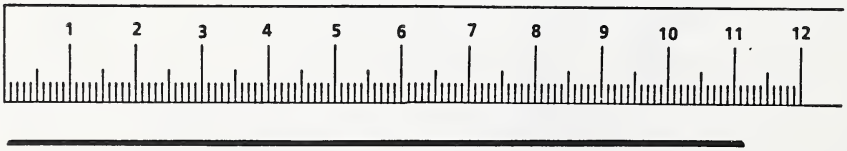
Hold the ruler face along the edge to be measured. This will reduce reading errors. Read the distance at the graduation closest to the measuring point.

In Canada, metric measurements are used in automotives.

A metric ruler measurement should be written in millimetres or centimetres (e.g., 15 mm or 1.5 cm), not a combination of centimetres and millimetres.



Sample 1: This line is 9 cm long.



Sample 2: This line is 112 mm long.

STUDENT ACTIVITIES

1. Using a metric ruler, draw lines of the following lengths:

   10 mm –
   1 cm –
   15 mm –
   2.5 cm –
   3.7 cm –

2. Measure the following lines to the nearest centimetre and record each answer on the line.

   ____

   ______

   ____

   ____

3. Measure the following lines to the nearest millimetre and record each answer on the line.

   ____

   ____

   ____

   ____

TORQUE WRENCHES

A torque wrench is a special type of tool with a measuring device attached. The wrench is used to tighten threaded fasteners to an accurate level of tightness, or TORQUE. Torque is defined as a twisting force.

A torque wrench enables a mechanic to measure the tightness of the screws according to specifications.

Failure to torque fasteners properly can cause:

- part breakage
- part warpage
- fastener breakage
- fastener stripping
- the parts to fall apart
- fluid leakage.

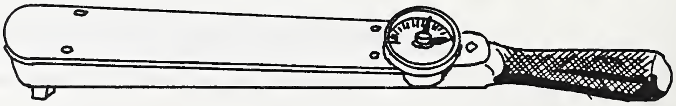
Parts that need to be torqued to manufacturers' specifications are:

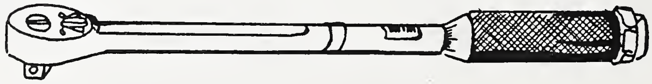
- cylinder heads – to prevent warpage
- valve covers – to prevent leakage
- wheel nuts – to prevent wheel rim distortion

Types of Torque Wrenches

There are three types of torque wrenches:

- beam type
- dial gauge type
- micrometer click type.





JOB SHEET 1
TESTING WITH A TORQUE WRENCH

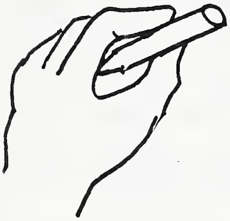
EQUIPMENT, TOOLS AND SUPPLIES

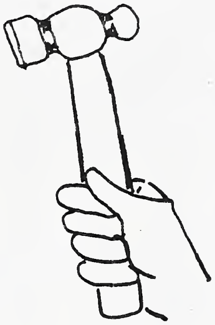
- Mild steel block, 2.5 cm x 5 cm, 6 mm thick
- Drill press
- Twist drills
- Hammer
- Centre punch
- Sockets and wrenches as required
- Ruler
- Safety glasses
- C-clamp
- Dust pan
- Bench vise
- Bolts and nuts — 6 mm NF, 8 mm NF, 10 mm NF
- Torque wrench, beam type or dial gauge type

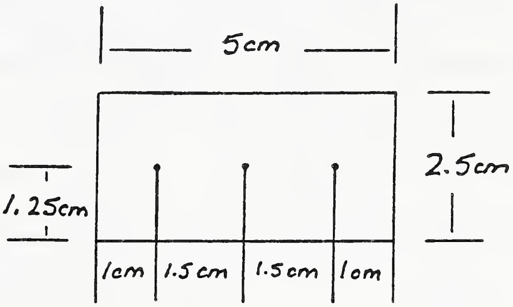
PROCEDURE

Note : Safety glasses must be worn during the marking, drilling and testing sections of this job sheet.

1. Mark out the hole locations as illustrated. Centre punch the locations.







2. Select three drill bits, so that each size bolt will slide easily through its particular hole.

3. Clamp the metal block in the drill press vise.

4. Clamp the drill press vise to the drill press table.

5. Drill the holes as illustrated.

6. Clean up the metal cuttings.

7. Mount the block in the bench vise.

8. Insert a screw into the first hole and attach a nut to it. Tighten the nut according to the specifications on the chart below.

9. On the chart, fill in the removal torque required to loosen the nut. Calculate the difference between the initial and removal torques.

10. While watching the gauge, slowly re-tighten the nut until it either breaks or strips.
    Note: The maximum torque is reached just before breakage or stripping occurs.

11. Record on the chart the maximum torque for each nut.

12. Repeat the procedure for the other two bolts and nuts.

13. Complete the chart.

Bolt Size	Initial Torque	Removal Torque	Difference	Maximum Torque	Did it Strip or Break?	Socket Size
6 mm	11 Nm					
8 mm	13.5 Nm					
10 mm	27 Nm					

14. Clean and return all equipment, tools and supplies to their proper storage areas.

15. Clean up the work area.

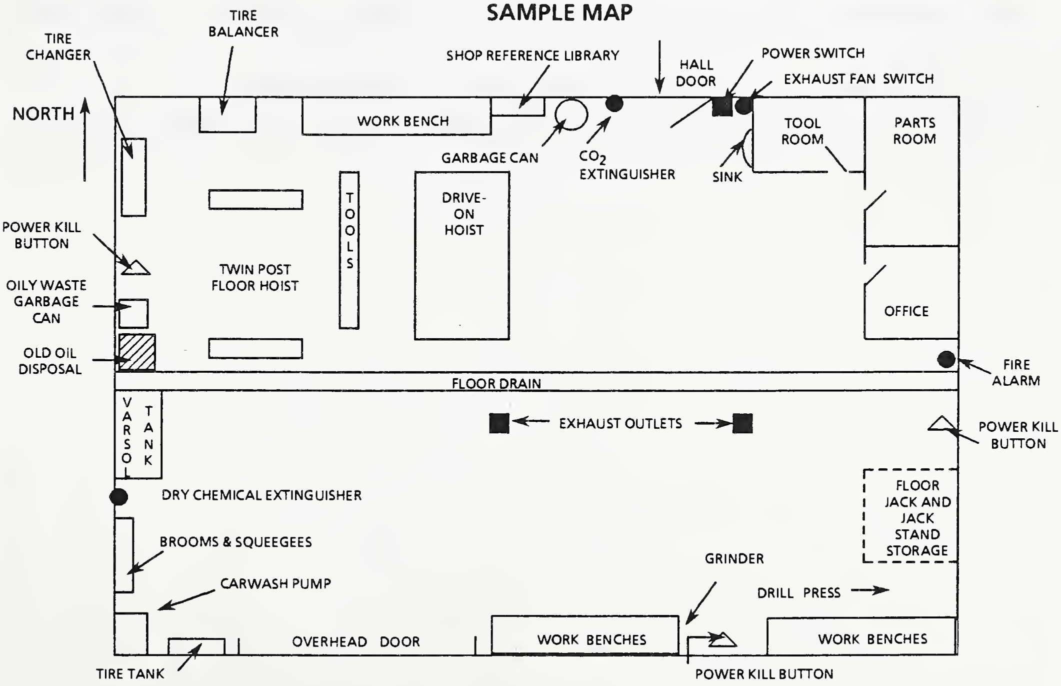
SHOP LAYOUT

To operate safely and efficiently in a shop or garage, each employee must know the work area thoroughly. Shops areas are designed for safety and ease of work.

Some concerns that must be considered when designing a shop include:

- Tools need to be stored for easy access.
- Brooms, and other cleaning equipment, must be stored neatly and out of the way.
- Fire alarms and fire extinguishers must be located in spots that can be reached quickly.
- Equipment must be kept away from water.
- Each item must have its proper, consistent storage location.
- Equipment, tools and supplies must be protected from theft.
- Proper disposal must be provided for waste oils, contaminated rags and toxic substances.

SAMPLE MAP



JOB SHEET 2
DRAWING A SHOP MAP

EQUIPMENT, TOOLS AND SUPPLIES

- Student workbook
- Paper
- Pencil
- Straightedge

PROCEDURE

1. Tour the shop with the teacher/supervisor.
2. Break into pairs.
3. Pace off the dimensions of the shop.
4. Make a sketch of the shop including all features noticed during the tour, and record them on the sketch.
5. Draw a NEAT scale diagram on the graph paper provided.

   Note: Depending on the shop size, a scale such as two squares per walking stride, could be used.
6. Compare your map with those of your classmates. Add any missing details.
7. Clean and return all equipment, tools and supplies to their proper storage areas.

HOISTS AND FLOOR JACKS

Often the service work on a vehicle will require a unit to be supported off the floor safely. Some of the services requiring this raised position include:

- oil changes
- tire work
- under vehicle inspections
- under vehicle mechanical work
- brake jobs.

The emergency jack supplied with a vehicle is not considered safe enough for shop use. Either hoists or floor jacks are used for lifting vehicles.

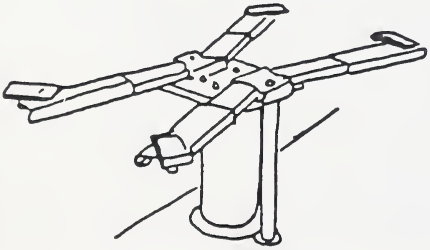
HOISTS

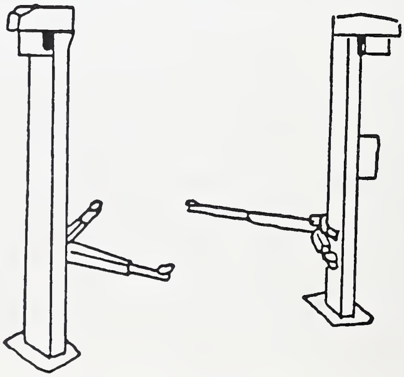
Hoists are used to raise the entire vehicle to permit inspections of the underside, and to perform service work. Hoists are powered by electricity, air or hydraulic oil. The movement of the hoist is controlled by either buttons or levers. Most hoists have built-in safety devices that lock the vehicle in a raised position making it safe for a person to work under. Each hoist manufacturer uses a different design; therefore, it is important to follow all operating instructions.

There are two main types of hoists:

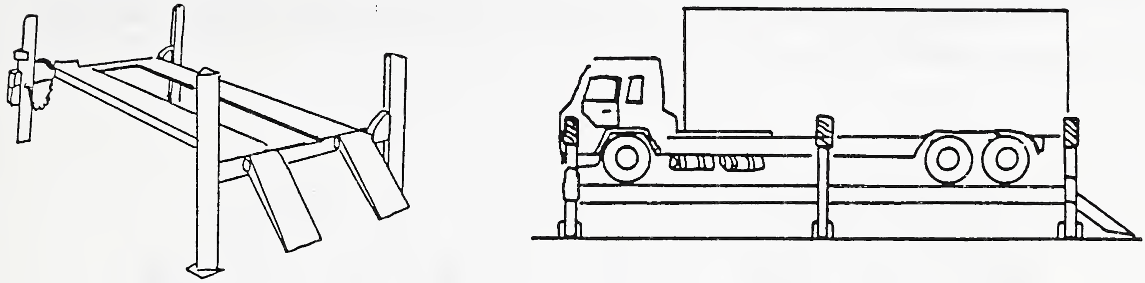
- frame contact hoists
- drive-on hoists.

A frame contact hoist may be constructed above or below ground. These hoists have arms that position the lifting pads in contact with the vehicle frame.



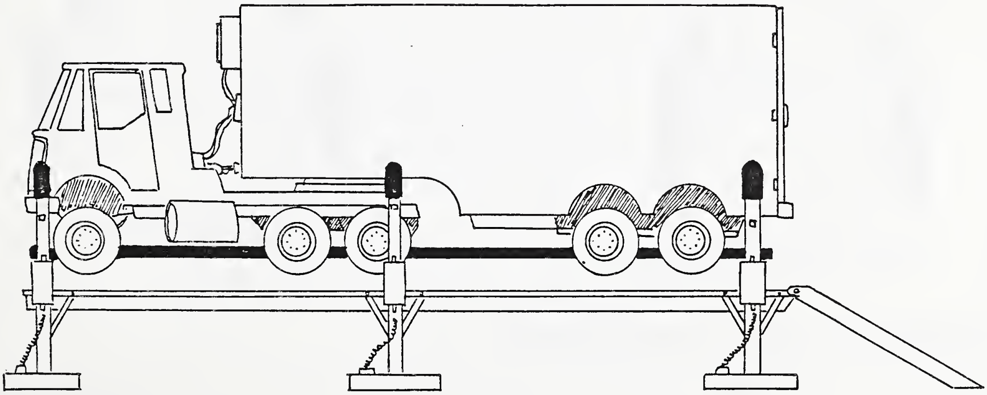


Drive-on hoists have a pair of ramps on which the vehicle is parked. The ramps can then be raised to the required vehicle height. This is called the loaded position, meaning that the vehicle is sitting on the ramp with its wheels supporting its own weight.



Loaded Position

Most drive-on hoists have an additional mechanical device that raises either the front end or rear end of the vehicle while it is parked on the hoist. This allows the wheels to be removed for service work. Supporting a vehicle in this manner is known as the unloaded or free wheel position.



Free Wheel Position

JOB SHEET 3

MAKING A HOIST DIAGRAM

EQUIPMENT, TOOLS AND SUPPLIES

- Pencil

PROCEDURE

1. In the space below, sketch and label a simple diagram of the hoist used in the school lab or in a community partner's workplace.

2. What type of hoist does your sketch represent?

____

3. What are its safety features?

____

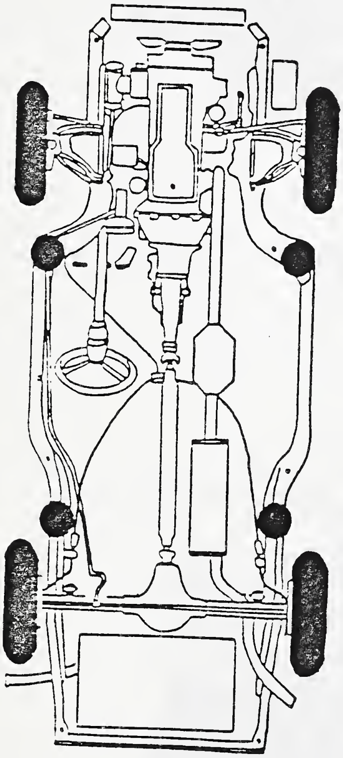
____

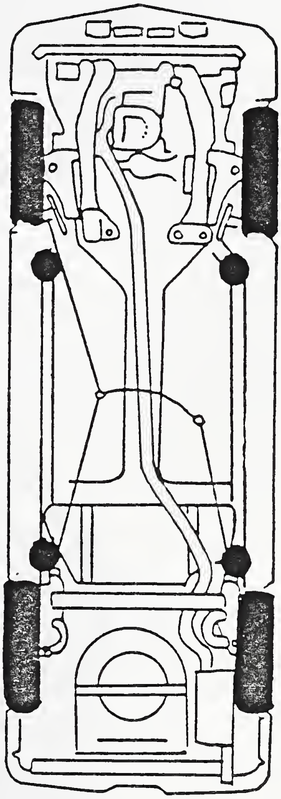
____

Lift Points

Lift points are the points on a vehicle where the hoist touches. These points are considered to be the positions from which the vehicle may be safely and securely suspended.

The location of lift points for particular vehicles may be found in operators' manuals or shop reference materials.

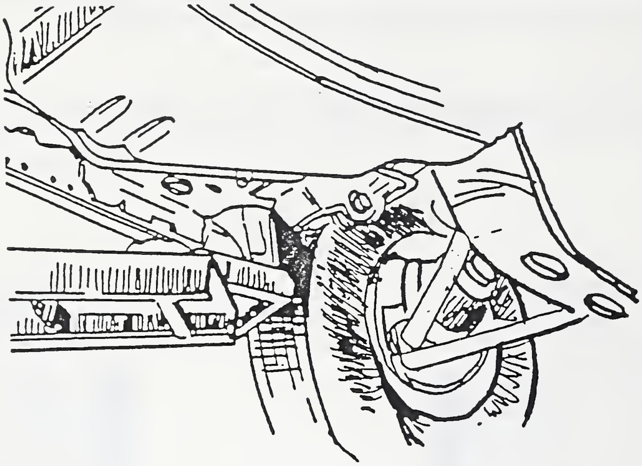




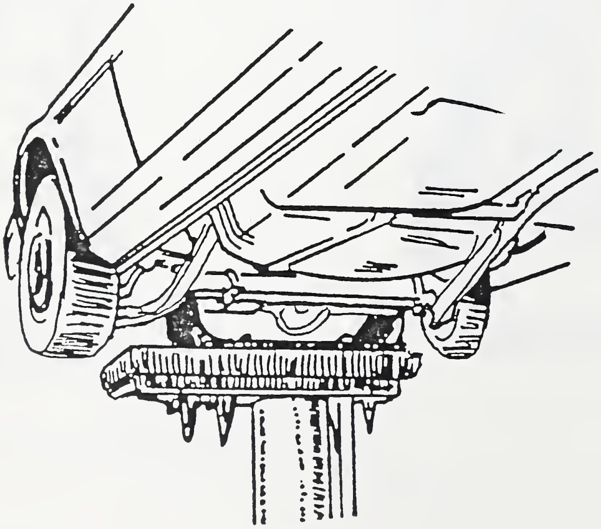
● – lift points

Note: To prevent accidents or damage, always identify the correct lift points before raising a vehicle on the hoist.

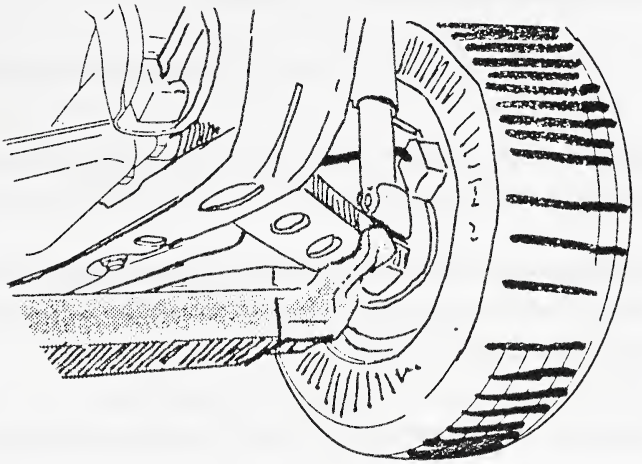
The following illustrations show how the vehicle is positioned and raised on a frame contact hoist.



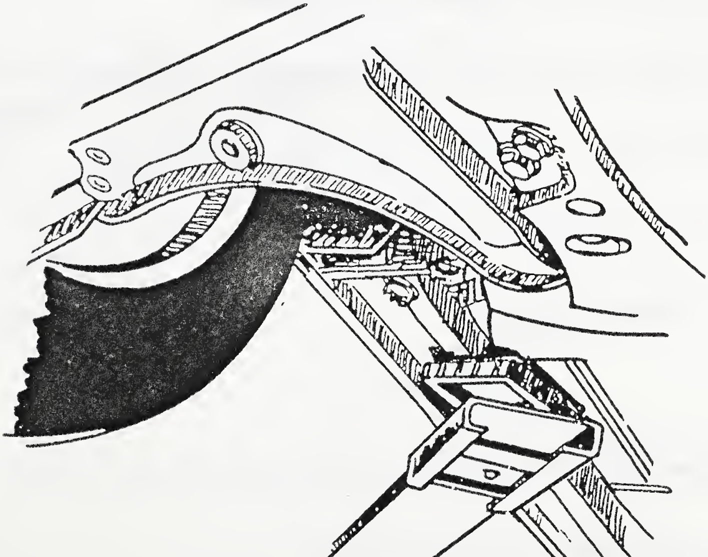
Frame Contact Hoist
- rearward of front tire



Frame Contact Hoist
- under rear axle assembly



Frame Contact Hoist
– under front lower control arm



Frame Contact Hoist
– forward of rear tire

Operating a Hoist

While each make and type of hoist has different operating procedures, there is a general sequence that should be followed when lifting or lowering a vehicle.

Lifting

1. Park the vehicle in a central position over the hoist. It is important for safe operation to spread the weight of the car equally in all directions.
2. Shut off the engine. Put the vehicle in park (neutral in a standard transmission). Apply the emergency brake to prevent the vehicle from rolling. Properly place wheel chocks (wedges), if available, to prevent the tires from rolling.
3. Select the lifting points and correctly position the lifting pads on the frame contact hoist.
4. Operate the buttons or levers to raise the hoist slowly so that the wheels of the vehicle are just clear of the floor.
5. Gently push the side of the vehicle to check that the vehicle is solidly supported. If the vehicle rocks, lower it to floor level and reposition the lifting pads.
6. If the vehicle is solidly supported, raise it to approximately 100 mm above the height desired.
7. Engage the safety locks.
8. Lower the vehicle until its weight is on the safety locks.
9. The vehicle is now safe to work on.

Lowering

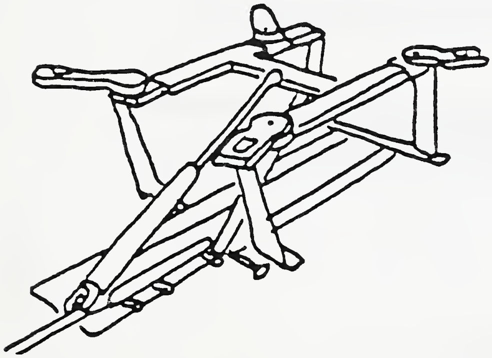
1. Check and remove any items (e.g., equipment, tools, rags) left under the hoist.
2. Raise the vehicle about 100 mm off the safety locks.
3. Release the safety locks.

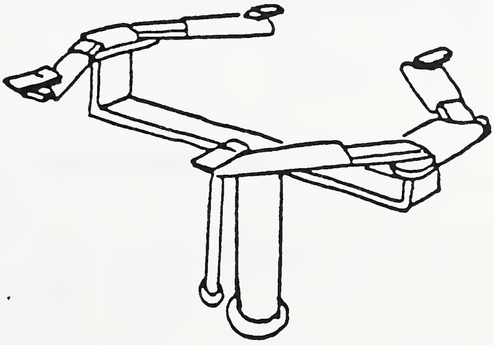
4. Slowly, lower the hoist until it is completely down.

Hoist Safety

While hoists are carefully designed, you must still obey the following safety rules in order to prevent accidents or injuries.

- Always put on the safety locks before going under any hoist.
- Position the vehicle carefully to spread out the weight to all four corners and prevent hoist damage over the long term.
- Wear eye protection (i.e., safety glasses or goggles) to prevent getting dirt, oil or other contaminants getting into your eyes.
- Never exceed hoist weight capacity.





JOB SHEET 4

USING A HOIST

EQUIPMENT, TOOLS AND SUPPLIES

- Hoist
- Vehicle

PROCEDURE

Note: This task should not be attempted until a hoist demonstration is observed.

1. Park the vehicle properly on or over the hoist.
2. Select suitable lifting points and position the hoist as required.
3. Verify the location of the lifting points with the teacher or supervisor.
4. Raise the vehicle to 100 mm higher than the required height.
5. Put on the safety locks.
6. Lower the vehicle onto the safety locks.
7. Perform the required service.
8. Raise the vehicle off the safety locks.
9. Disengage the safety locks.
10. Lower the vehicle.
11. Carefully back the vehicle off the hoist.
12. Clean up the work area.

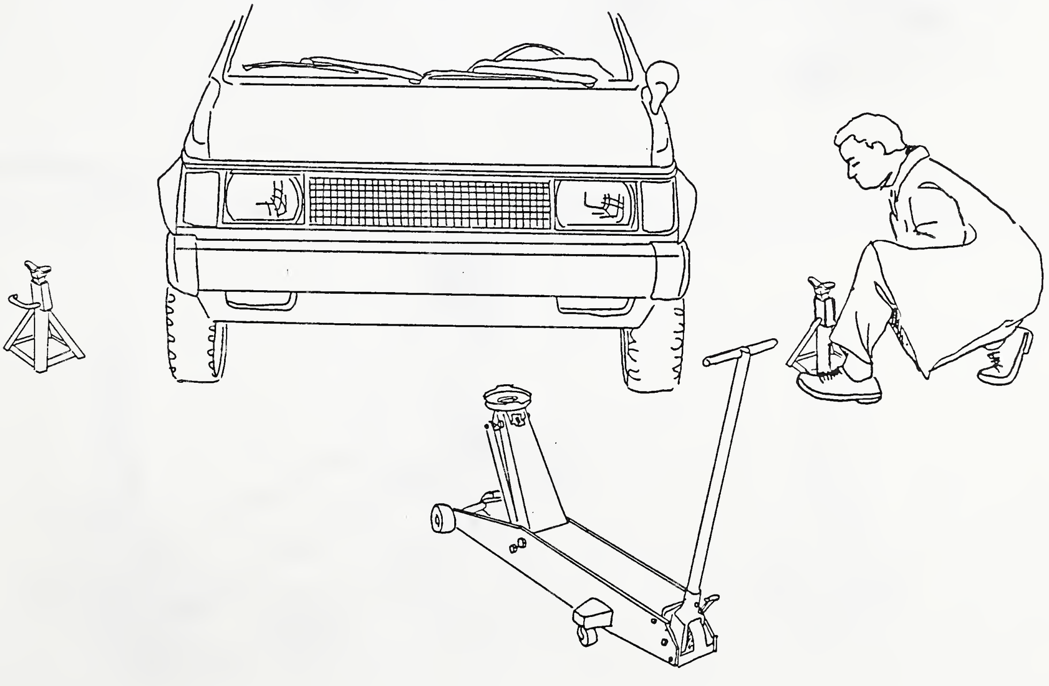
FLOOR JACKS

Floor jacks are used to raise the vehicle in preparation for placing on jack stands. Floor jacks are much safer and more powerful and stable than are the jacks provided by vehicle manufacturers.

To ensure safety when using floor jacks:

- Select a lift point that will raise the vehicle in a level position without causing damage.
- Never go under a vehicle suspended on a floor jack. Jack stands are mechanical devices designed for long-term support. A floor jack may fail and cause the vehicle to fall.
- Never exceed the recommended floor jack weight capacity.

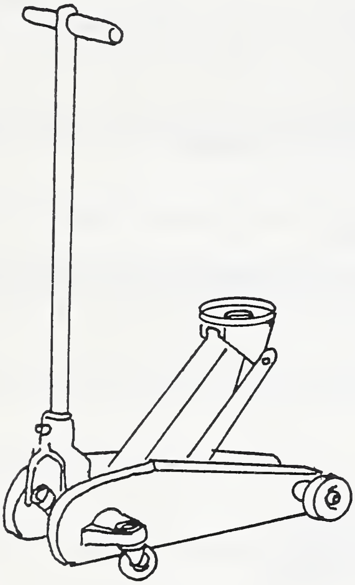
  Note: The weight capacity of a floor jack can be found on the attached labels or identification plate.

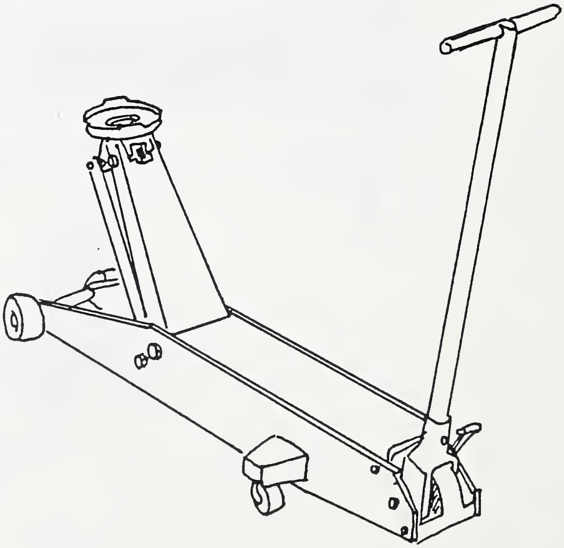


Several types of floor jacks are available for different lifting set-ups.

Single Point Floor Jacks

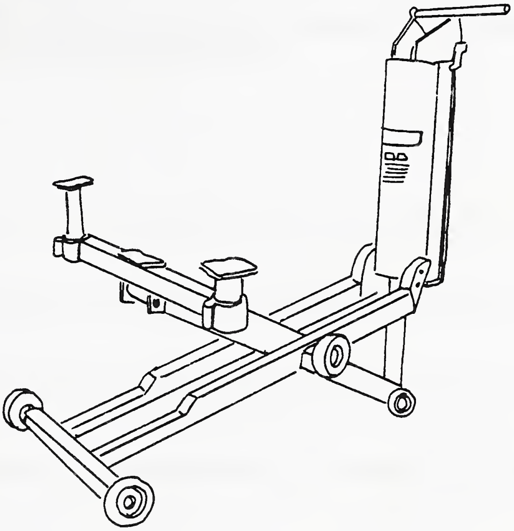
Lift Set-up: Used when the end of the vehicle can be lifted at one central spot (e.g., rear axle housing).





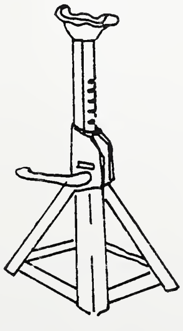
Multipoint Floor Jacks

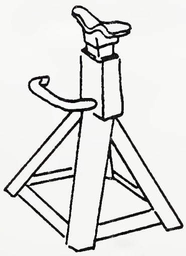
Lift Set-up: Used for stability or when the vehicle's construction does not provide a central location for lifting without damage (e.g., some front wheel drive vehicles).

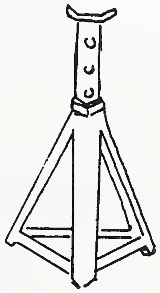


Jack Stands

Jack stands do not lift a vehicle. They are used to support a unit during raised service operations.







JOB SHEET 5
MAKING A FLOOR JACK DIAGRAM

EQUIPMENT, TOOLS AND SUPPLIES

- Pencil

PROCEDURE

1. In the space below, sketch and label the parts of a floor jack available in the school lab or in the workplace.

2. Answer the following questions.

   - What is the weight capacity of this floor jack? ____________________
   - Where is the floor jack's weight capacity indicated? ____________________
   - When might the floor jack be used instead of a hoist?

     ____

     ____

   - What safety precautions must be taken when using a floor jack?

     ____

     ____

     ____

JOB SHEET 6

SELECTING FLOOR JACK LIFTING POINTS

EQUIPMENT, TOOLS AND SUPPLIES

- Front wheel drive vehicle suspended on jack stands
- Rear wheel drive vehicle suspended on jack stands
- Available floor jacks
- Shop reference materials listing lifting points

PROCEDURE

Select the correct lifting points for jacking up front and rear wheel drive vehicles.

1. Examine the underside of the vehicles and note the areas of strongest construction.

2. Check the shop reference materials to verify the location of the correct lift points.

3. Draw a simple diagram below to illustrate the lift points of each vehicle.

Lift Points of a Front Wheel Drive Vehicle

Lift Points of a Rear Wheel Drive Vehicle

4. Answer the following questions.

   Is one type of floor jack suited to lift both types of vehicles? Why or why not?

5. Clean and return all equipment, tools and supplies to their proper storage areas.

6. Clean up the work area.

JOB SHEET 7
USING A FLOOR JACK

EQUIPMENT

- Vehicle
- Jack stands (4)
- Floor jack of suitable capacity

PROCEDURE

Note: Job Sheet 7 should be undertaken only after the teacher/supervisor has demonstrated how to use the floor jacks and jack stands.

Lifting

1. Select correct front lift point (i.e., front cross member). If you are unsure of where to place the saddle, ask the teacher/supervisor for help in selecting the correct location.

2. Position the floor jack until the raised saddle is in contact with the selected lift point.

3. Close the control knob.

4. Pump the jack handle to raise the vehicle to approximately 100 mm above the desired height.

5. Position the jack stands under the frame and raise them to contact the selected support point on both sides of the vehicle.

6. Slowly lower the vehicle on the jack stands.

7. Close the control valve to hold the saddle about 10 mm away from the lift point.

8. Gently push the side of the vehicle to check its stability.
   Caution: If vehicle rocks, reposition jack stands for proper stability before proceeding.

9. Repeat procedures (1–8) for the rear of the vehicle. Select the rear lift points such as the centre of the rear axle assembly or area under rear spring saddles.
   Note: When the vehicle is supported on jack stands, the body must sit level.

10. Remove the floor jack.

Lowering

1. Position the floor jack saddle under selected rear lift point.
2. Raise the vehicle approximately 100 mm above jack stands.
3. Remove the jack stands.
4. Slowly lower the vehicle to the floor.
5. Repeat the process for the front of the vehicle.
6. Clean and return all equipment, tools and supplies to their proper storage areas.
7. Clean up the work area.

SAFETY

Safety is everyone's business. Each employee in an automotive repair shop is responsible for his or her own safety, the safety of other employees, and the safe use of equipment, tools and supplies and customers' vehicles.

Safety practices related to specific tasks performed by automotive mechanics and mechanics' helpers are included in the job sheets that follow. General and personal safety practices in the workplace include:

GENERAL SAFETY

To protect everyone's safety:

- No machine, tool or equipment shall be used until the student has received complete instruction on safe use practices.
- No equipment or tools shall be operated without permission.
- No equipment or tools shall be operated without supervision.
- Know the location of fire extinguishers, the different types, and how to use them.
- Know what to do in case of an emergency.
- No vehicle shall be worked on without the teacher's or supervisor's permission.
- If a hazard is noticed, notify the teacher or supervisor immediately.
- Wipe up all floor spills immediately.

PERSONAL SAFETY

To protect your own safety:

- Do not use damaged equipment or tools.
- Do not wear jewellery, rings, watches or clothes that might restrict safe use of equipment and tools.
- Keep hair cut short, tied back or covered to prevent it from being caught by rotating machinery.
- Wear proper protective clothing for the job; e.g., goggles, steel-toed boots or shoes, coveralls.

STUDENT ACTIVITIES

1. Brainstorm: What are some of the potential hazards when working in an automotive shop? List ten:

2. What should be done if another worker has an accident? Discuss and list the steps to follow when an accident occurs.

3. What should be done if the fire alarm sounds in the automotive shop?

4. What other special safety rules apply to the school or community partner's shop?

5. Read and complete the "Student Safety Pledge Form" below.

STUDENT SAFETY PLEDGE FORM

______________________________, who is enrolled in Automotive Services 16, will, as a part of the learning experience, operate equipment and tools, providing written parental/guardian permission is given.* Each student will be given proper instruction, both in the use of the equipment and tools and in correct safety procedures, before being allowed to work alone. Because the student must assume responsibility for following safety practices, we ask that he or she subscribe to the following safety pledge.

- I PROMISE TO FOLLOW ALL SAFETY RULES.
- I WILL NOT ASK PERMISSION TO USE AN ITEM OF EQUIPMENT OR TOOLS UNLESS I HAVE BEEN INSTRUCTED IN ITS USE.
- I WILL REPORT ANY ACCIDENT OR INJURY IMMEDIATELY TO THE TEACHER/SUPERVISOR.

DATE ___________ STUDENT'S SIGNATURE ______________________________

I hereby give my consent to allow my son or daughter to operate all equipment and tools necessary to carry out the tasks in this course.

DATE ___________ PARENT'S/GUARDIAN'S SIGNATURE ______________________________

Parents/Guardians are cordially invited to visit and arrange to view any tasks performed by the students.

* Parental/Guardian's consent is necessary only if the student is a minor.

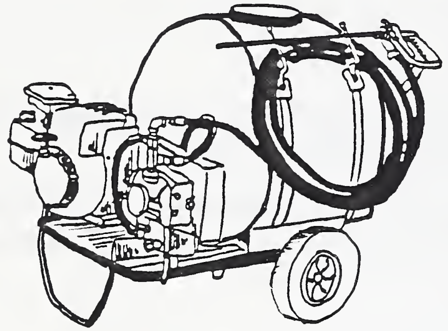
CLEANING VEHICLES

One of the first jobs given to many entry-level automotive service workers is washing cars and trucks. DETAILING is the automotive term used to describe the thorough cleaning and polishing of a vehicle's exterior and interior. Clean vehicles look better to their owners or may be easier to sell. Cleaning also removes road film, slows down rusting and prevents other damage to the surface of the vehicle.

The following equipment is used to detail vehicles:

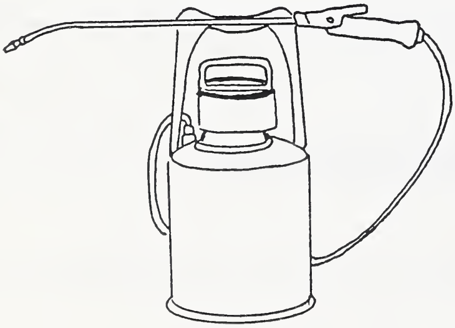
Pressure Washers

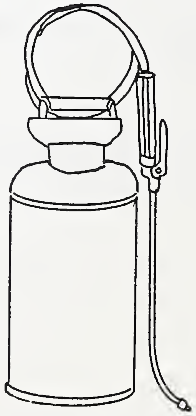
These machines mix soap and water to produce a high pressure spray to wash the exterior of a car. Never point the spray gun wand at another person; the high pressure water and chemicals can cause serious injury.



Booster Sprayers

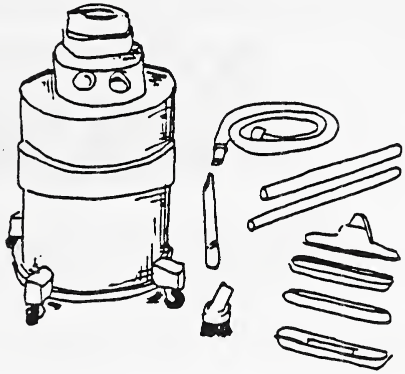
This equipment sprays liquid chemicals on the surface of the area to be cleaned. Always check the chemical container labels to ensure that proper safety precautions are taken.





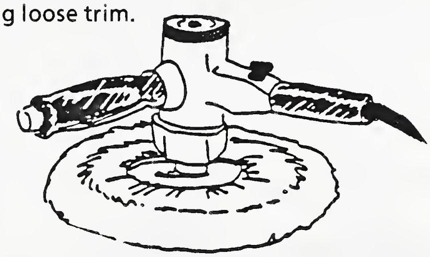
Vacuum Cleaners

High powered vacuum cleaners are used to clean a vehicle's upholstery, rugs and trunk surfaces.



Power Polishers

These units spin soft polishing pads to buff wax applied to the vehicle's surface. Although polishers spin fairly slowly, avoid polishing loose trim.



Other detailing tools and supplies include:

Tools	Supplies
sponges	car wash soap
rags	degreasers
hoses	waxes/glazes
brushes	polishing compounds
steel wool	vinyl cleaners
squeegees	vinyl dressings
chamois	chrome polishes
pails	tire cleaners

JOB SHEET 8

WASHING A VEHICLE

EQUIPMENT, TOOLS AND SUPPLIES

- Pressure washer
- Car wash soap
- Car wash mitt or brush
- Vacuum cleaner
- Vinyl cleaner
- Window cleaner
- Paper towels

PROCEDURE

1. Park the car in the wash bay, then remove the mats and roll up all of the windows.

2. Clean the interior:
   a. wipe off all vinyl surfaces
   b. empty and clean out the ashtray
   c. clean the windows
   d. vacuum or scrub the floor mats
   e. vacuum the upholstery
   f. vacuum the rugs
   g. replace the floor mats.

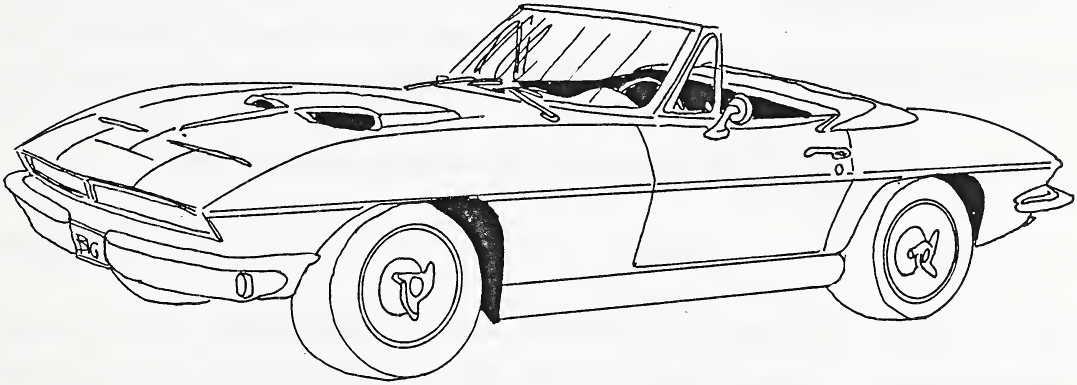
3. Clean the trunk with the vacuum cleaner.

4. Clean the exterior:
    a. spray a strong soap solution on the tire side walls and scrub them with a brush
    b. wash the car exterior with a pressure washer and hand wash with the car wash mitt or brush
    c. rinse the car thoroughly with water
    d. chamois the car dry.

5. Return the car to the parking area.

6. Clean up the wash bay and squeegee any excess water into the drain.

7. Return all of the equipment, tools and supplies to their proper storage areas.



AUTOMOTIVE FASTENERS

A **FASTENER** is anything that holds two or more parts together. If the fastener fails, an accident could happen. To reduce the chances of this happening, fasteners are designed to be strong and durable.

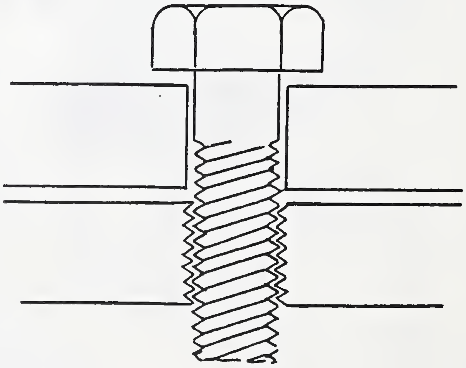
In order for a fastener to be durable, it must have the following qualities:

- **STRENGTH** – it has to be strong enough to withstand compression (squeezing) loads, tension (pulling) loads and shearing (sliding) loads.
- **REUSEABLE** – most fasteners must be able to be used over and over again.
- **EASY TO REMOVE** – to remove a part from a car, the fastener should be easy to detach. On the other hand, it must not fall apart too easily.
- **VIBRATION-PROOF** – it should be able to withstand vibrations without the need for repeated tightening.
- **LONG-LASTING** – it should not wear out or deteriorate over time.
- **CORROSION RESISTANT** – it should not be affected by water, salt, gasoline or acids.
- **TEMPERATURE RESISTANT** – it should be able to stand the maximum or minimum temperatures to which it will be exposed.

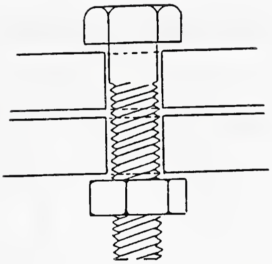
CAP SCREWS, BOLTS, STUDS AND MACHINE SCREWS

Cap screws, bolts, studs and machine screws are the most common automotive fasteners.

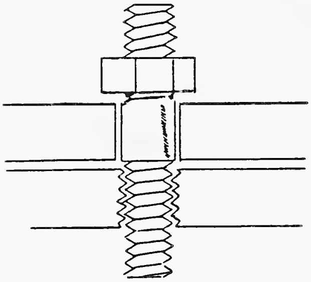
A CAP SCREW is a threaded fastener, usually with a hexagonal (six-sided) head. It passes through a hole in one piece and threads directly into a hole in a second piece. The threaded end of a cap screw is 6 mm or larger in diameter.



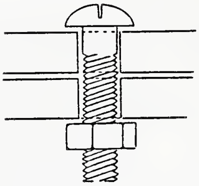
A BOLT is a cap screw with a hexagonal nut on its threaded end. The cap screw passes through a hole in each of two pieces and then the nut is threaded on, clamping both pieces together.



A STUD is a round rod with threads on both ends. The stud threads into one piece, the second piece fits over the stud, and then a hexagonal nut threads onto the stud holding the second piece in place.



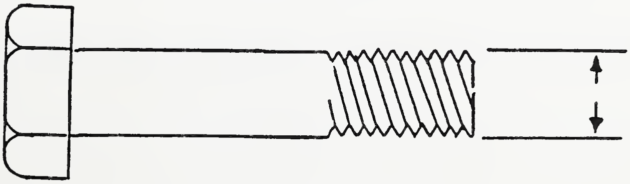
A MACHINE SCREW is very similar to a cap screw except that it is smaller than 6 mm in diameter and is used with a screwdriver. It may be used with a nut.



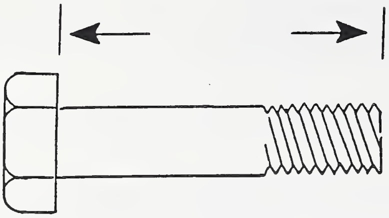
MEASURING CAP SCREW SIZES

Cap screws come in various lengths, diameters and thread varieties (pitches). The following rules must be learned in order to describe and identify the various cap screws used in the automotive shop.

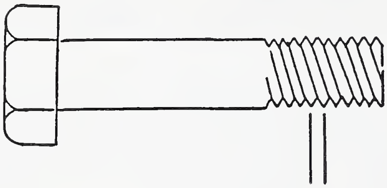
- The SIZE of the cap screw is measured across the diameter of the threaded end.



- The LENGTH of the cap screw is determined by measuring the distance from below the cap screw head to the very end of the threaded part. Metric cap screws are measured to the nearest 5 mm EXCEPT on cap screws shorter than 25 mm.

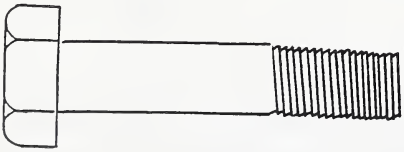


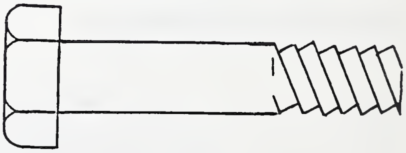
- The PITCH of metric cap screws is determined by measuring the distance from the top of one thread to the top of the thread next to it. This is easiest when done using a THREAD PITCH GAUGE.



The pitch is used to determine the metric (ISO) thread series. There are two THREAD SERIES:

- coarse
- fine

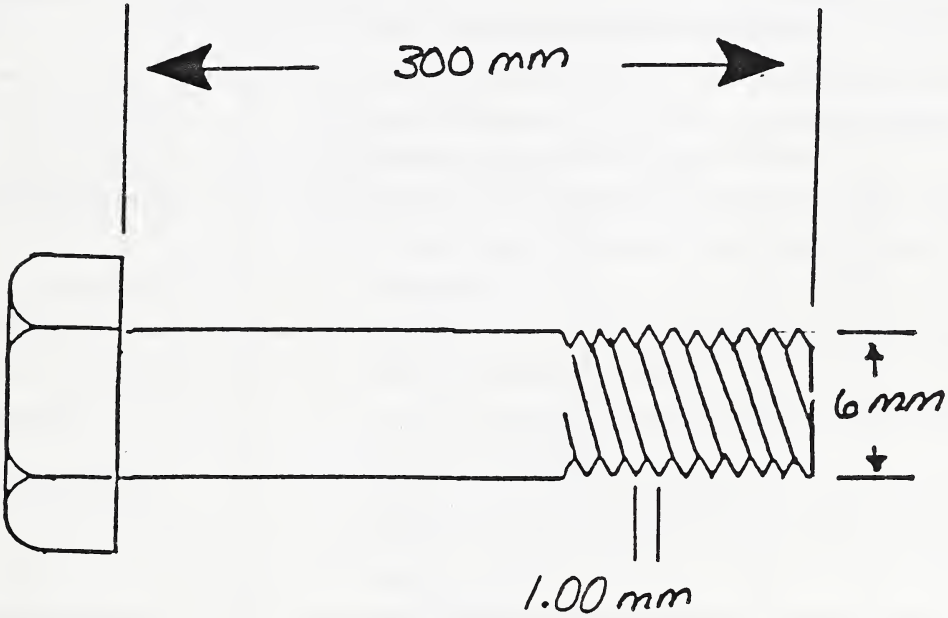




A coarse threaded cap screw has fewer threads per 25 mm of length than has a fine threaded cap screw.

DESCRIBING CAP SCREWS

Cap screws are described by quoting the size, length and thread pitch. Metric cap screws are described by the following means. A cap screw 6 mm in diameter, 30 mm long with a pitch of 1.00 mm would be an M6 x 30 x 1.00 cap screw (the 'M' denotes that it is a metric cap screw).



JOB SHEET 9
DESCRIBING CAP SCREWS

EQUIPMENT, TOOLS AND SUPPLIES

- Ten different cap screws
- Thread pitch gauges

PROCEDURE

1. Measure the size, length and pitch of each of the cap screws.

2. Complete the chart below for the ten cap screws. Follow the example shown.

Cap Screw	Size	Length	Pitch	Proper Description
e.g.	6 mm	30 mm	1.00 mm	M6 x 30 x 1.00
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

3. Clean and return all equipment, tools and supplies to their proper storage areas.

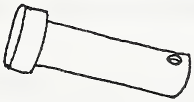
4. Clean up the work area.

OTHER AUTOMOTIVE FASTENERS

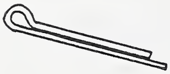
A list and illustrations of some of the other common automotive fastener follows. Study the illustration of these fasteners as you read through the description of each.

• **Clevis pin**	• Used as a removable pivot for levers or other moving parts such as brake pedals and transmission linkages.
• **Cotter pin**	• Used to lock a castle nut permanently onto a bolt. Used on front-end steering parts.
• **Flat washer**	• Spreads the bolt tightening load over a wider area, which prevents part damage. It can also be used to make a large hole smaller.
• **Lockwasher**	• Prevents a nut or cap screw from loosening. It has sharp corners which dig into the nut and part.
• **Rivet**	• A soft fastener inserted into holes in two pieces of steel and then deformed with a hammer to prevent it from falling out. It is used to assemble a car or truck frame.
• **Self-tapping screw**	• It cuts its own thread in soft sheet metal. Used to hold on trim and other lightweight items. Also known as a sheet metal screw.
• **Set screw**	• A headless screw, usually with an Allen recess, used to clamp gears and pulleys onto shafts.
• **Snap ring**	• Prevents gears and bearings from moving on shafts;or other parts from separating.
• **Socket head bolt**	• This has an Allen recess in its head. It is usually made of high strength steel and is used where bolt head damage may occur.
• **Spring lock pins**	• Many different types and shapes are available. They are used to hold carburetor linkages on and, together, hold brake disc pads in place, etc.
• **Square key**	• Similar to a woodruff key in purpose. However, the square key is weaker and has a square profile. It is designed to break if an abnormal force is applied.
• **Stud**	• Used in place of cap screws. A stud makes it easier to line up holes from one part to another; e.g., cylinder heads, valve covers, differentials.

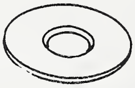
• Thread locking compound	• Used to prevent thread fasteners from loosening.
• Toothed lockwasher	• Sometimes called a shakeproof washer, the toothed lockwasher prevents the screw from vibrating loose. The teeth can point either in or out.
• Wing nut	• Used to hold down air cleaner lids and spare tires.
• Woodruff key	• A half moon shaped key. Used to hold gears and pulleys on shafts and to keep them from turning on the shaft.



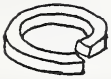
Clevis Pin



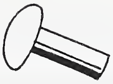
Cotter pin



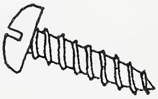
Flat Washer



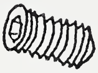
Lock Washer



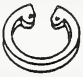
Rivet



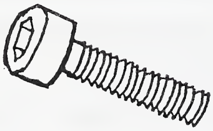
Self-Tapping Screw



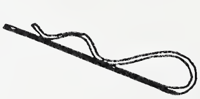
Set Screw



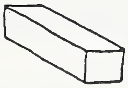
Snap Ring



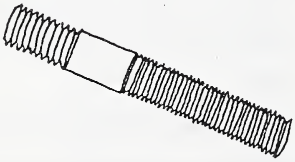
Socket Head Bolt



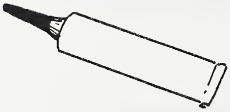
Spring Lock Pin



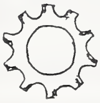
Square Key



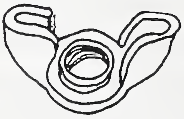
Stud



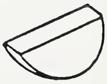
Thread Locking Compound



Toothed Lock Washer



Wing Nut



Woodruff Key

JOB SHEET 10

IDENTIFYING FASTENERS

EQUIPMENT, TOOLS AND SUPPLIES

- A box containing ten different fasteners, each one identified by a numbered tag
- Pencil

PROCEDURE

1. Match the tag number with the item number below and insert the correct fastener name on the blank line provided

    1. ______________________________
    2. ______________________________
    3. ______________________________
    4. ______________________________
    5. ______________________________
    6. ______________________________
    7. ______________________________
    8. ______________________________
    9. ______________________________
    10. ______________________________

2. Clean and return all equipment, tools and supplies to their proper storage areas.

3. Clean up the work area.

MAJOR VEHICLE PARTS

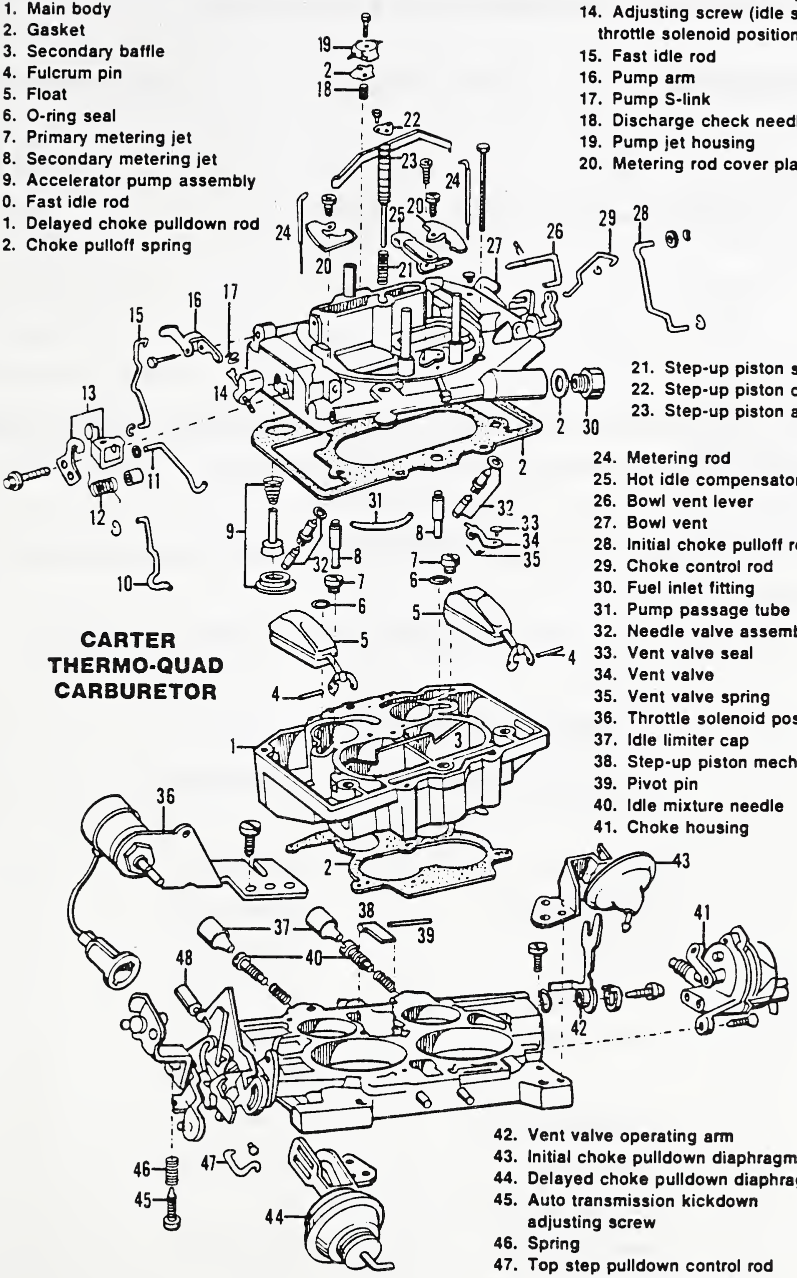
There are over 10,000 separate parts in a modern automobile. It is almost impossible to know the names of all these parts. Still, there are major parts that should be readily recognized.

These parts include the:

- body
- frame
- suspension
- drive train
- engine and under hood area
- electrical system.

Because there are so many different types of vehicles on the road today, it is impossible to be familiar with all the parts of each one. Most automotive service employees, however, must know the general location and shape of common parts.

An illustration of a disassembled carburetor is shown on the following page. Remember that this is just a very small part of the whole car.



CARTER THERMO-QUAD CARBURETOR

1. Main body
2. Gasket
3. Secondary baffle
4. Fulcrum pin
5. Float
6. O-ring seal
7. Primary metering jet
8. Secondary metering jet
9. Accelerator pump assembly
10. Fast idle rod
11. Delayed choke pulldown rod
12. Choke pulloff spring
13. Choke pulloff assembly
14. Adjusting screw (idle speed with throttle solenoid positioner off)
15. Fast idle rod
16. Pump arm
17. Pump S-link
18. Discharge check needle
19. Pump jet housing
20. Metering rod cover plate
21. Step-up piston spring
22. Step-up piston cover plate
23. Step-up piston and link
24. Metering rod
25. Hot idle compensator
26. Bowl vent lever
27. Bowl vent
28. Initial choke pulloff rod
29. Choke control rod
30. Fuel inlet fitting
31. Pump passage tube
32. Needle valve assembly
33. Vent valve seal
34. Vent valve
35. Vent valve spring
36. Throttle solenoid positioner (TSP)
37. Idle limiter cap
38. Step-up piston mechanical lifter
39. Pivot pin
40. Idle mixture needle
41. Choke housing
42. Vent valve operating arm
43. Initial choke pulldown diaphragm
44. Delayed choke pulldown diaphragm
45. Auto transmission kickdown adjusting screw
46. Spring
47. Top step pulldown control rod
48. Fast idle adjustment screw

Illustration from Clymer Publications, Dodge and Plymouth 2 and 4 Wheel Drive, Full Size, 1988, page 230. Reprinted with permission.

JOB SHEET 11

IDENTIFYING THE MAJOR PARTS OF VEHICLES

EQUIPMENT, TOOLS AND SUPPLIES

- Vehicle on a hoist
- Vehicle on the ground
- Wall charts, automotive textbooks or other reference materials
- Clipboard

PROCEDURE

1. On the two vehicles in the shop, identify as many of the items as possible from the lists below. Check the spaces to the right of the names when each part is identified.

2. When all the parts are located, ask the teacher/supervisor to check your knowledge of the location of each part.
   Note: Directions such as right, left, front or back are taken from the driver's seat position.

PARTS TO IDENTIFY

BODY PARTS

Hood ______
Trunk lid ______
Right door ______
Front bumper ______
Left front fender ______
Kick panel ______
Grille ______
Windshield ______
Driver's doorpost ______
Rocker sill ______

SUSPENSION PARTS

Coil spring ______
Shock absorber ______
Ball joint ______
Leaf spring ______
Grease nipples ______

STEERING PARTS

Steering box ______
Steering column ______
Steering wheel ______
Idler arm ______
Tie rod ends ______

ENGINE PARTS

Distributor ______
Spark plugs ______
Oil dip stick ______
Oil filler cap ______
Fan belt ______
Water pump ______
Radiator ______
Air cleaner ______
Fan ______
Valve cover ______
Oil pan ______
Oil filter ______
Fuel pump ______

DRIVE TRAIN PARTS

Transmission ______
Driveshaft ______
Front drive axle ______
Rear axle housing ______
Universal joint ______
Standard transmission ______
Differential filler plug ______
Rear crossmember ______

ELECTRICAL PARTS

Alternator ______
Battery ______
Ignition switch ______
Headlights ______
Signal lights ______
Horns ______
Windshield wipers ______
Starter motor ______
Voltage regulator ______
Ground cable ______

OTHER UNDER-CAR PARTS

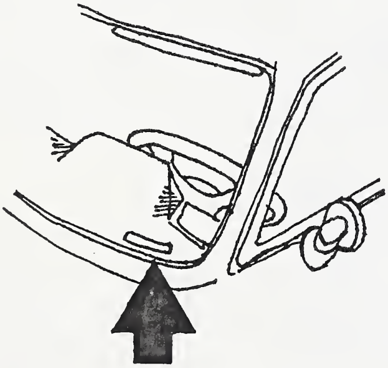
Tail pipe ______
Muffler ______
Exhaust manifold ______
Gas tank ______
Frame ______
Lower rad hose ______
Emergency brake cable ______
Bell housing ______
Motor mount ______
Transmission oil pan ______

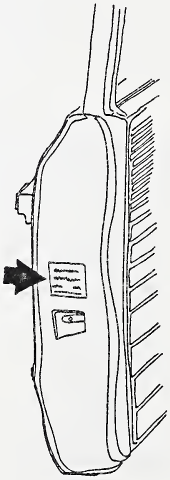
USING IDENTIFICATION NUMBERS

For mechanics to locate a particular vehicle in the parking lot, obtain the correct parts for it and then be able to repair it, they must know how to identify the vehicle according to its identification numbers. While the licence plate number will identify the customer's vehicle it does not provide the specific information required for repairs.

VIN TAGS

The VIN (**VEHICLE IDENTIFICATION NUMBER**) is a long number that identifies the type of car, model year, where it was built and the car unit number. The repair manual, parts books or other sources provide charts for interpreting VIN. The VIN is located on a metal tag at the base of the windshield on the driver's side. It is also found on a decal or metal plate on the inside of the driver's door or on the side doorpost.





The decal or plate on the doorpost also includes the DATE OF MANUFACTURE, TIRE PRESSURE, GROSS VEHICLE WEIGHT (GVW), and other information. These decals must never be removed, ground off or painted over.

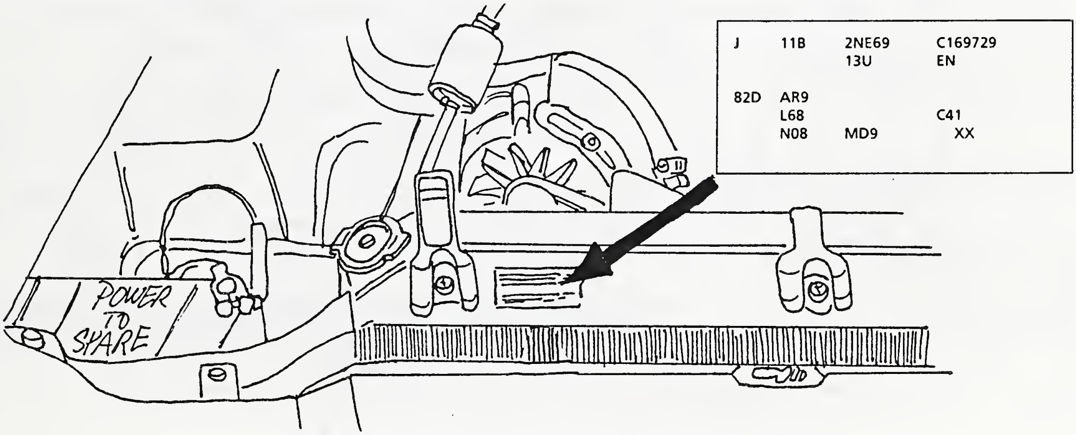
SERIAL NUMBERS

This six digit number identifies one particular vehicle out of all similar vehicles of that year. This number forms part of the VIN. The serial number may be required if the manufacturer changed to different parts within a single year's production.

Serial numbers are also required to:
- complete a bill of sale
- obtain insurance
- purchase licence plates.

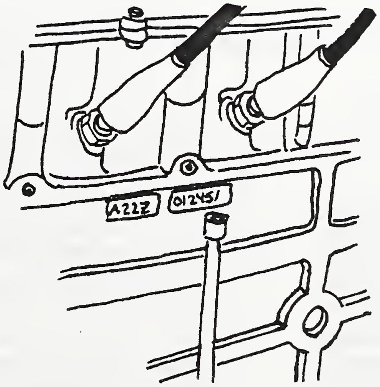
BODY IDENTIFICATION NUMBER

Some manufacturers have a BODY IDENTIFICATION PLATE under the hood which lists codes related to the body style, paint colour, trim codes and other information needed to order new parts.

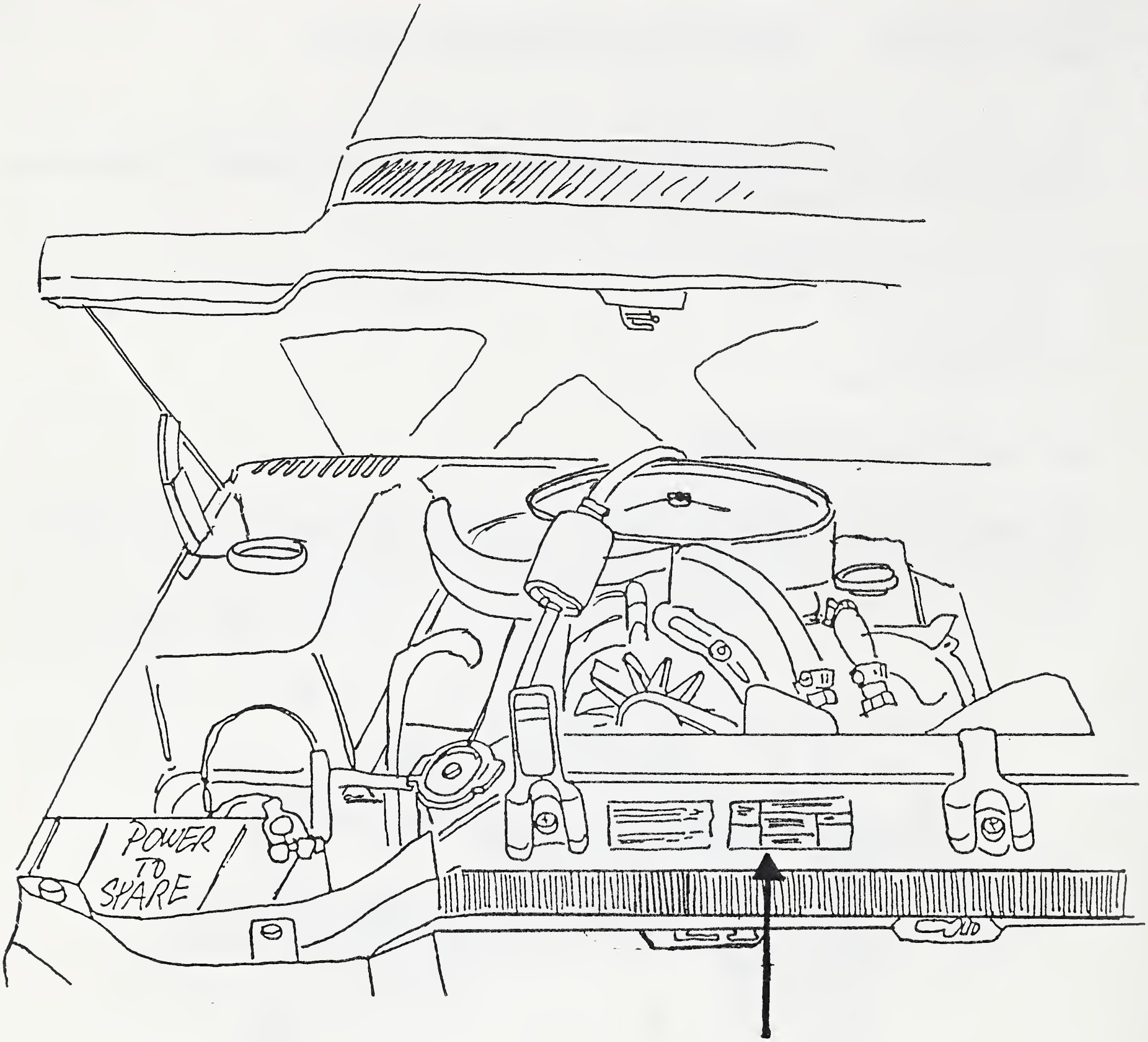


OTHER PARTS NUMBERS

Many parts, like the distributor, carburetor, rear axle assembly and engine, have their own identification numbers. These numbers are required to order parts for these assemblies. The number found on the part is then checked against a list in a parts catalogue. Once the right number is located in the catalogue, the partsperson can then obtain the correct part for the mechanic.



The numbers are located on metal tags attached to the part, or stamped right onto the part itself.



CKM 2.5 Liter J1G2 5V5 TPG4 JAO–1C	**VEHICLE EMISSION CONTROL INFORMATION**	
	Spark Plug Gap 0.060 No adjustment provisions exist for idle fuel mixture, idle speed or ignition timing. See service manual and maintenance schedule for additional information.	**CATALYST** BPEGR/ORC
	This vehicle conforms to Transport Canada Emissions Regulations applicable to 1990 model year passenger cars.	

JOB SHEET 12

INTERPRETING VEHICLE IDENTIFICATION NUMBERS

EQUIPMENT, TOOLS AND SUPPLIES

- Vehicle with a carburetor
- Shop manual suited to that vehicle
- Trouble light
- Pencil

PROCEDURE

1. Locate the VIN plate.

2. Copy ALL of the information found on the VIN plate onto the following page.
    a. Locate the carburetor. You will have to remove the air cleaner assembly. Get a piece of paper and sketch the air cleaner on it. Now draw in all of the hoses that you are disconnecting and where they belong.

       Note: Do this while taking them off — not afterward. This will ensure that you will be able to reassemble them in the right spots.

    b. Locate and record the carburetor tag number.

    c. Locate and record the distributor and find the distributor number.

3. Reinstall the air cleaner assembly. Make sure all the hoses are put back where they belong.

4. Locate the engine serial number and copy the number down in the appropriate space on the worksheet.

5. Have the teacher/supervisor check the hose and air cleaner installation.

6. Clean and return all equipment, tools and supplies to their proper storage areas.

7. Clean up the work area.

STUDENT ACTIVITIES

1. What is the make and model of the vehicle used?

   e.g., Make = Chevrolet; Model = Camaro Z28

   Make ______________________________

   Model ______________________________

2. Draw the VIN plate, as found on the doorpost, in the space below. Include all information on the plate.

3. What is the date of vehicle manufacture?

   Month ________ Year __________

4. What is the vehicle's serial number?

   ____

5. What is the name of the company that manufactured the vehicle?

   ____

6. What is the carburetor number?

   ____

7. What is the distributor number?

   ____

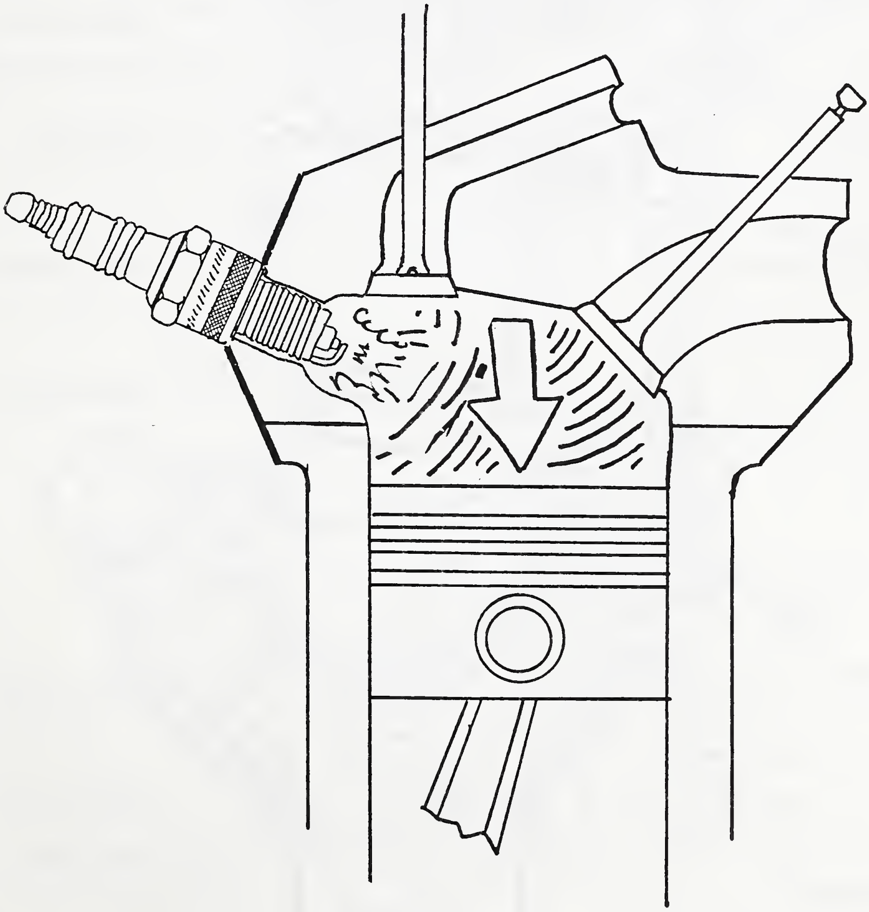
8. What size is the engine?

   ____

INTERNAL COMBUSTION ENGINES

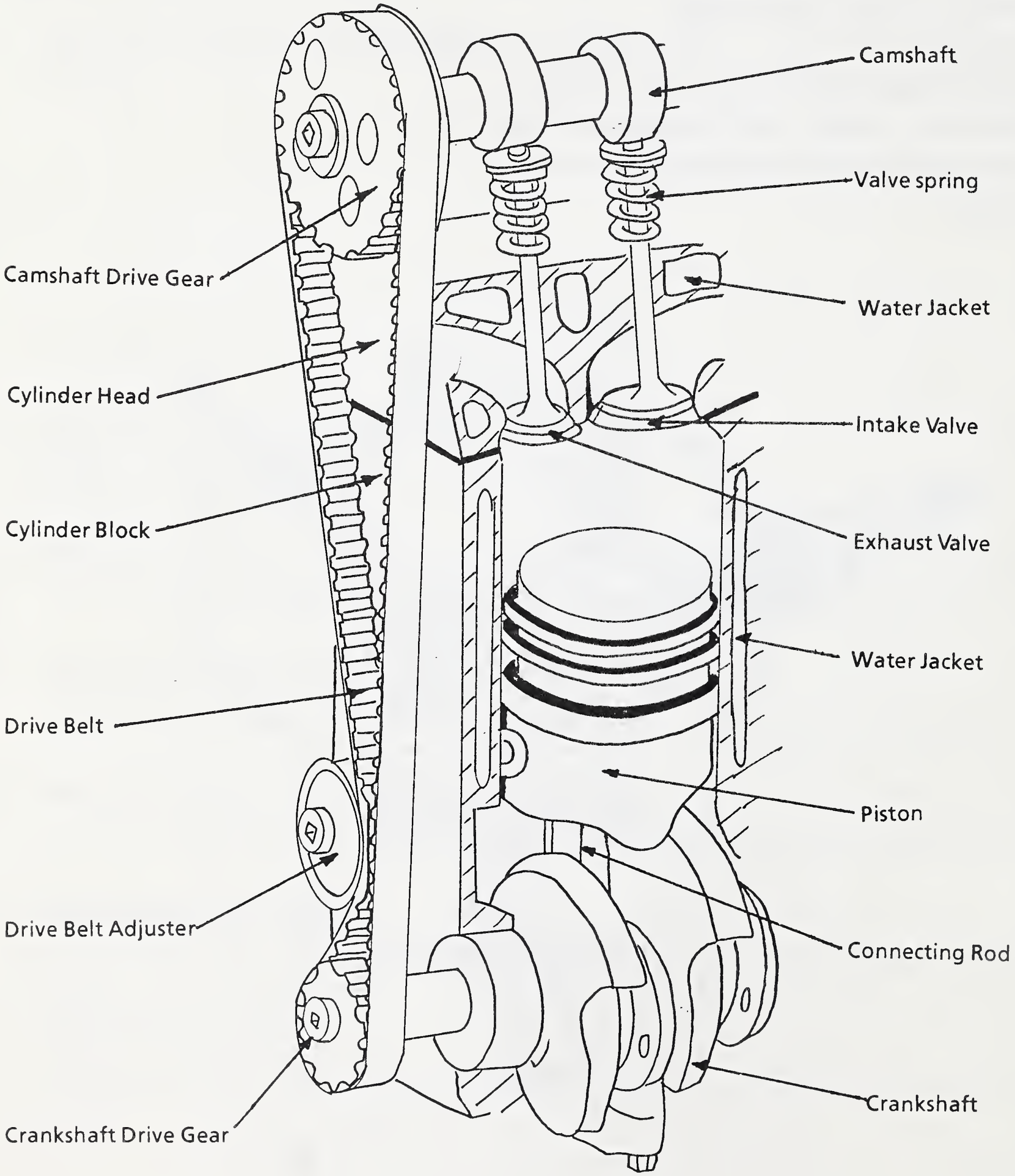
The power source for nearly all modern vehicles is the internal combustion engine. **An engine is any machine that burns fuel to produce usable energy.** The term internal combustion means burning within. Internal combustion engines burn a fuel, such as gasoline, to produce usable energy in the form of rotating mechanical energy.

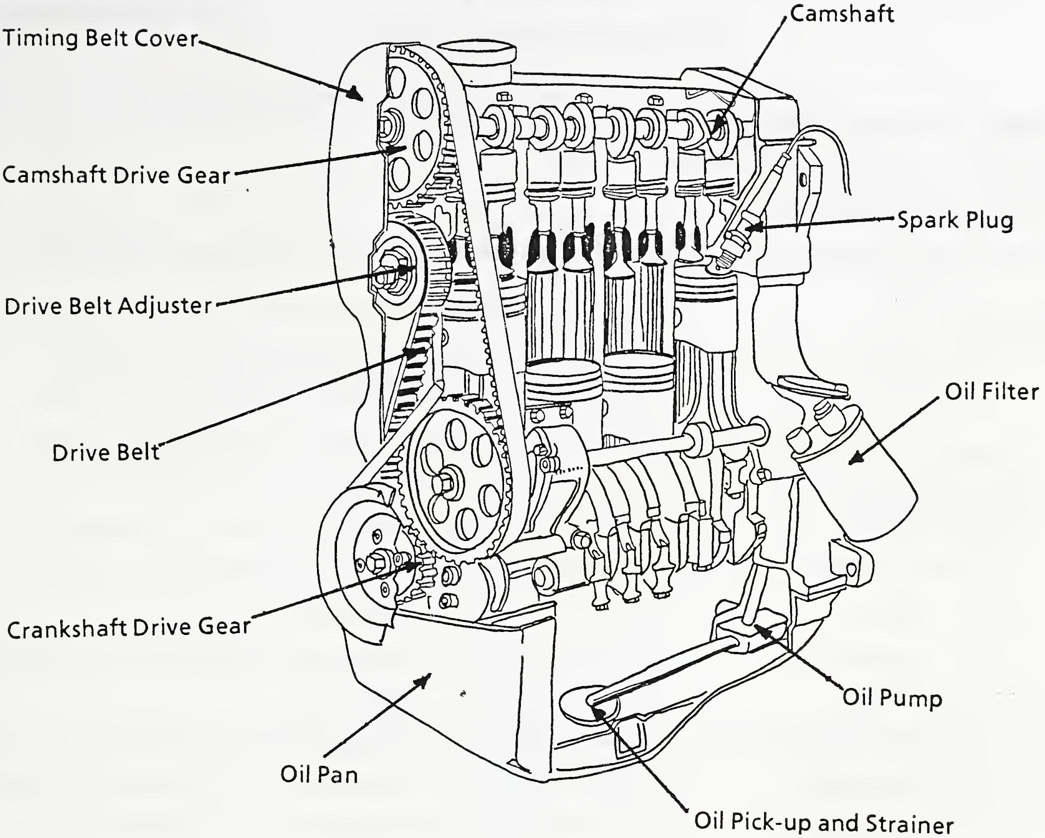
The mechanical energy is produced by burning a fuel inside a cylinder. The fire heats up the air which expands and drives the piston down in the cylinder.

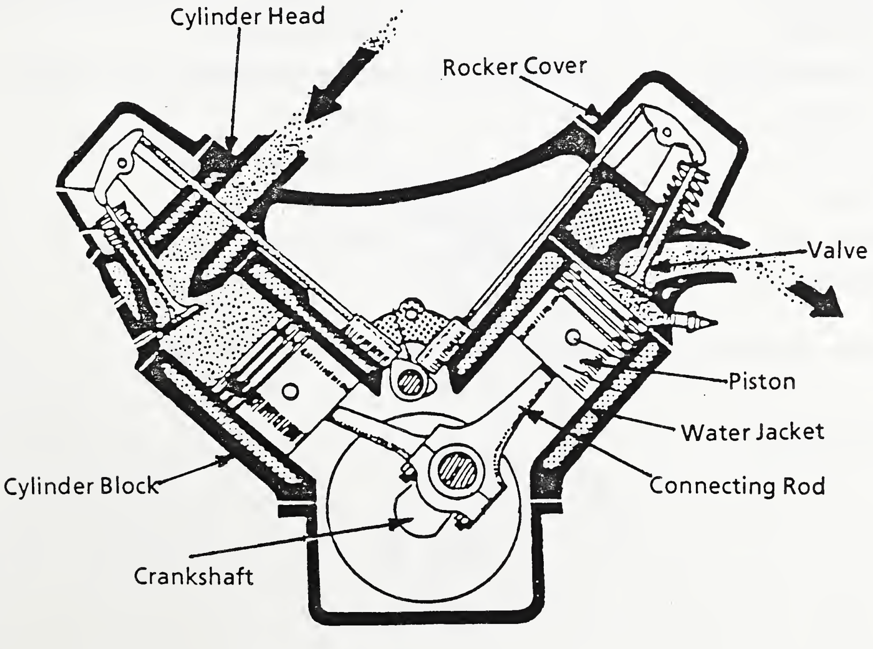


ENGINE PARTS

Each engine is composed of hundreds of parts. There are many different engine designs. All common internal combustion engines use similar parts. Mechanics need to know the names of major engine parts. The illustrations below show these parts.




Timing Belt Cover
Camshaft
Camshaft Drive Gear
Spark Plug
Drive Belt Adjuster
Oil Filter
Drive Belt
Crankshaft Drive Gear
Oil Pump
Oil Pan
Oil Pick-up and Strainer


Cylinder Head
Rocker Cover
Valve
Piston
Water Jacket
Cylinder Block
Connecting Rod
Crankshaft

JOB SHEET 13
IDENTIFYING ENGINE PARTS

EQUIPMENT, TOOLS AND SUPPLIES

- Engines on benches or engine stands
- A bin of various engine parts
- Resource materials such as wall charts, pictures, textbooks which aid in engine parts identification

PROCEDURE

Note: All of the parts in the bin and those on the engines have identification numbers on them.

1. Using the above resources, write the correct engine part identification number beside its name in the chart below:

________ Block
________ Cylinder head
________ Piston
________ Connecting rod
________ Crankshaft
________ Push rod
________ Valve spring
________ Valve lifter
________ Crankshaft pulley
________ Distributor
________ Spark plug
________ Oil pan
________ Intake valve
________ Exhaust valve
________ Rocker arm
________ Rocker cover
________ Piston pin
________ Crankpin
________ Oil pump
________ Oil filter
________ Water pump
________ Intake manifold
________ Exhaust manifold
________ Carburetor
________ Cylinder head bolt
________ Camshaft
________ Timing chain

2. Clean and return all equipment, tools and supplies to their proper storage areas.

3. Clean up the work area.

ENGINE OPERATION

There are three elements needed for an engine to run.

- AIR
- FUEL
- IGNITION

For an engine to run, the following must happen.

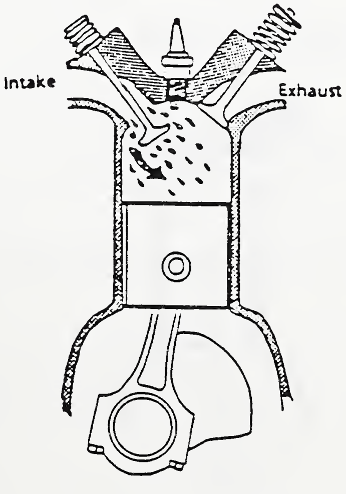
- The AIR must be compressed to heat it up.
- The FUEL and air must be mixed in just the right amounts.
- A spark for IGNITION must be present to cause the air-fuel mixture to explode.

There have been a variety of methods invented to burn the air-fuel mixture in the cylinder. One method, the four stroke cycle, has been the standard in the automotive industry for many years.

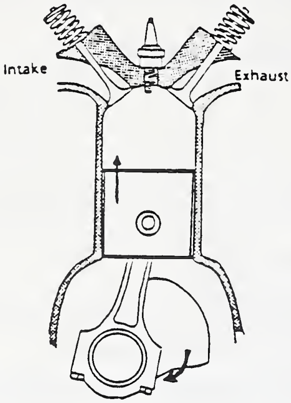
4-STROKE CYCLE ENGINE

A cycle is a series of predictable events which occur over and over without interruption. The four stroke cycle engine has four actions which repeat themselves over and over. Each action happens during a STROKE, the up or down motion of the piston inside the cylinder. The four strokes are intake, compression, power and exhaust.

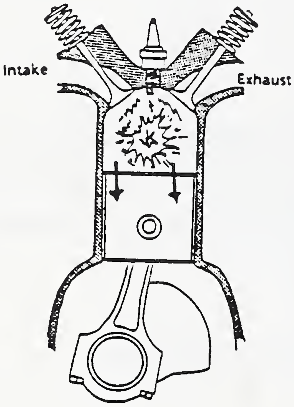
1. INTAKE – to fill the cylinder with the air-fuel charge.



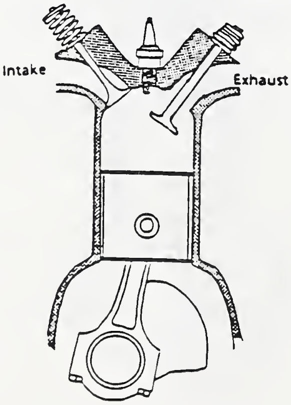
2. COMPRESSION – to squeeze the air-fuel mixture into a smaller space and pre-heat the charge.



3. POWER – to ignite and burn the air-fuel charge. This causes expansion, thus producing downward pressure on the piston.



4. EXHAUST – to remove the spent gases from the cylinder.



REMEMBER!

- If one or more of the three BASIC REQUIREMENTS is missing, the engine will NOT run.
- The order of the strokes is ALWAYS the same.
- An engine always starts on the intake stroke.
- The ignition, or SPARK, occurs on the power stroke.
- If any one of the four strokes does not perform properly then the engine will NOT run.

To control the explosion in the cylinder the mechanic must ensure that there is:

- a sufficient supply of air
- the correct amount of fuel
- a sufficient ignition spark at the correct time.

STUDENT ACTIVITIES

1. What is meant by "internal combustion"?

2. What is meant by the term "cycle"?

3. What three things are required to get any engine to run?

4. In the correct order, name the four strokes of the four stroke cycle engine.

   a.
   b.
   c.
   d.

Operation of the 4-Stroke Cycle Engine

The four stroke cycle engine has four distinct STROKES or piston movements. The piston is the plug inside the cylinder that is driven downward by the exploding gasoline mixture. There are at least two valves in each cylinder to let the air-fuel mixture into the cylinder (**intake valves**) and let the burnt gases back out of the cylinder (**exhaust valves**). These valves are opened by the **camshaft** and closed by the **valve springs**.

The chart below shows the four strokes, the direction that the piston moves inside the cylinder, the valve positions and what is happening inside the cylinder during that particular stroke. By following through the chart you will be able to understand how the four stroke cycle internal combustion engine operates.

Stroke	Piston Direction	Valve Position		Purpose
		Intake	Exhaust	
INTAKE	down ↓	open	closed	Air-fuel mixture is pushed into the cylinder by atmospheric pressure as the piston is moving down.
COMPRESSION	up ↑	closed	closed	The mixture inside the cylinder is squeezed, pre-heating the charge and making it more explosive and easier to ignite.
POWER	down ↓	closed	closed	The spark plug ignites the mixture. The piston is pushed downward by the expanding gas in the cylinder.
EXHAUST	up ↑	closed	open	The piston pushes the burnt exhaust gases out of the cylinder.

STUDENT ACTIVITIES

1. Complete the following chart on the 4-stroke cycle engine's operation, without looking at the previous page.

Stroke	Piston Direction	Valve Position		Purpose
		Intake	Exhaust	
INTAKE				
COMPRESSION				
POWER				
EXHAUST				

2. Brainstorm the following questions with your classmates and record the answers.

- What would happen if the exhaust valve was open on the intake stroke?

  ____

- What would happen if the intake valve was open on the power stroke?

  ____

- What would happen if the intake valve was open on the exhaust stroke?

  ____

ENGINE SUPPORT SYSTEMS

An engine is a collection of mechanical parts that require the help of a number of engine support systems in order to operate properly.

Fuel System – mixes air and fuel in the right proportions for all operating conditions.

Cooling System – removes excess heat, promotes fast warm-up and keeps engine at proper operating temperature.

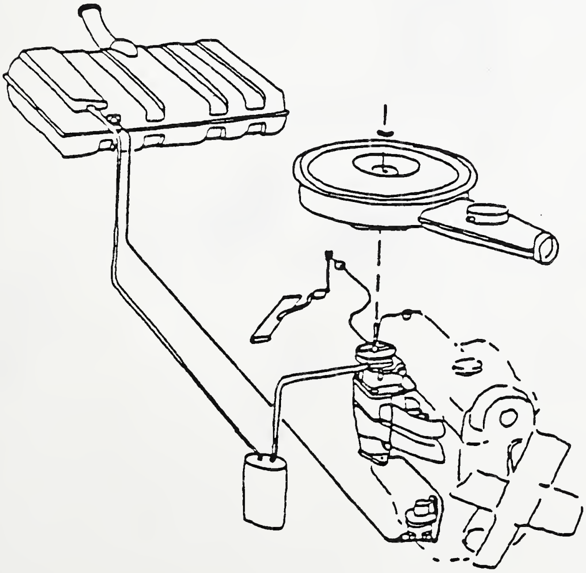
Lubrication System – reduces friction, cleans inside of engine and seals parts, such as piston rings.

Ignition System – provides a hot spark in the cylinder at the right time to ignite the fuel.

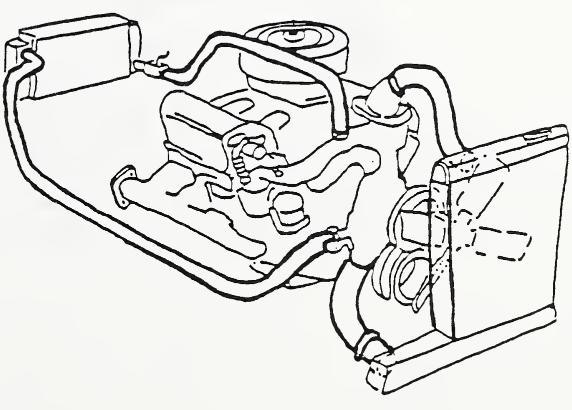
Air Intake or Induction System – cleans and directs air into the engine. Prevents flames from escaping if engine backfires.

Exhaust System – removes exhaust from engine area and quiets the sound of the hot gases.

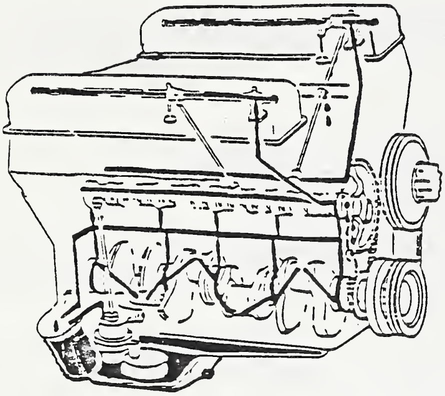
The following illustrations show each of these support systems.



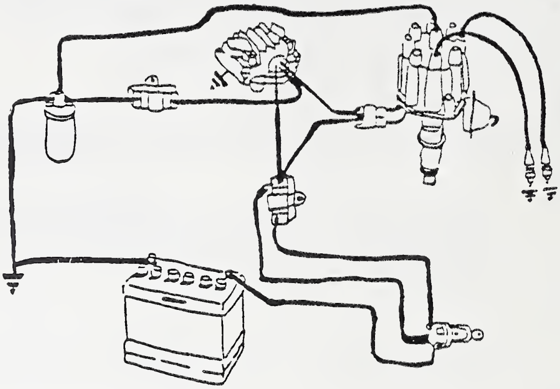
Fuel System



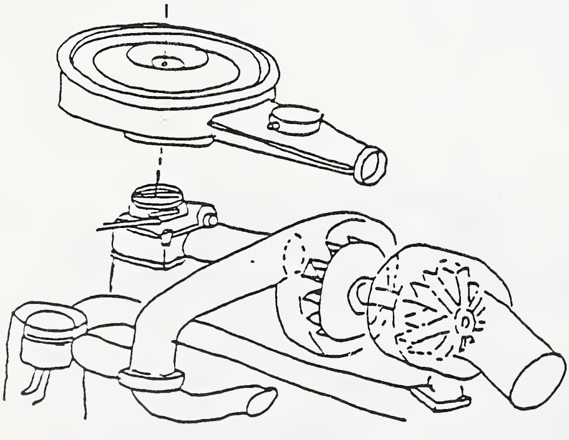
Cooling System



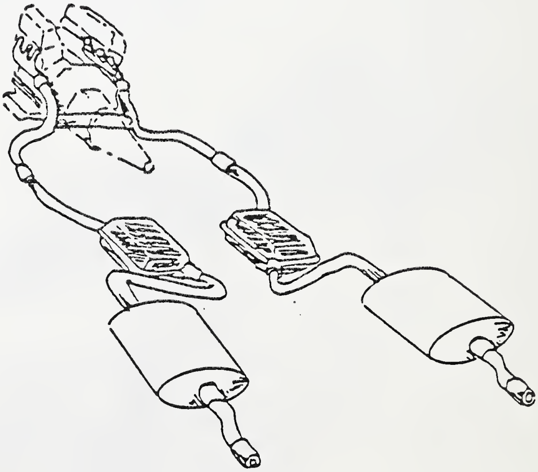
Lubrication System



Ignition System



Air Intake or Induction System



Exhaust System

STUDENT ACTIVITIES

1. Using automotive references, identify each of the previous engine support system illustrations. Write the correct name of each support system below the illustration.

2. Brainstorm and record the answers to the following questions:

   - What is meant by the term "system"?

     ____

   - List an example where the term "system" is used to describe the human body.

     ____

3. What could happen if one support system fails to operate properly? How could other systems be affected?

   ____

   ____

LUBRICANTS

COMMON AUTOMOTIVE LUBRICANTS

A LUBRICANT is any sort of item that will reduce friction or rubbing between two parts. Oil is a good lubricant, but there are many other specialized lubricants found in auto shops. Some common examples are described below.

• **Chassis Grease**	Chassis grease is used to lubricate the grease fittings of a vehicle. It is soft, sticky, won't absorb water, and will last a long time. Chassis grease is applied with a grease gun.
• **Wheel Bearing Grease**	Wheel bearing grease should only be used to lubricate a vehicle's wheel bearings. It is a thick grease that works better at higher temperatures. Wheel bearing grease is sold in tubs or pails and is squeezed into the wheel bearings by hand or with a bearing packer.
• **Graphite Grease**	A black, messy grease used on front wheel drive axles.
• **Gear Oil**	This oil is used in standard transmissions and differentials. It is specially designed to withstand the high wiping pressures found in these units. Gear oils designed for differential use are also referred to as "hypoid" oils.
• **Power Steering Fluid**	A fluid similar to automatic transmission fluid used in power steering pumps.
• **Silicon Spray**	A lubricant used to let rubber parts slide smoothly and stop parts from squeaking.
• **Penetrating Oil**	Liquid used to break down rust and free up seized parts.

STUDENT ACTIVITIES

1. Identify the following lubricants which are used in the lab or auto shop and list the brand and type for each.

	BRAND	TYPE
Wheel Bearing Grease	________________	________________
Chassis Grease	________________	________________
Gear Oil	________________	________________
Power Steering Fluid	________________	________________
Silicone Spray	________________	________________

Other lubricants:

________________	________________	________________
________________	________________	________________
________________	________________	________________
________________	________________	________________
________________	________________	________________

ENGINE OILS

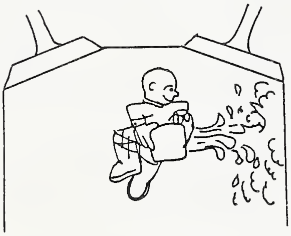
Engine or motor oil is the most important engine lubricant. Without oil an engine will come to a grinding halt in a few seconds.

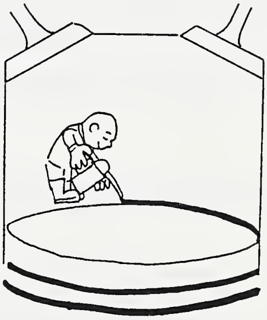
The automotive service employee needs to know as much as possible about available engine oils so that when it is time to change the oil the correct choice can be made.

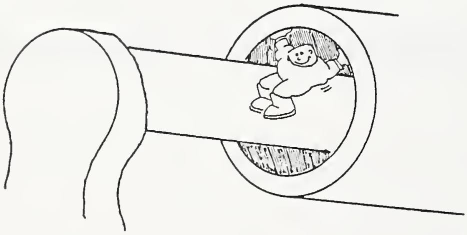
Customers, too, need information about oil, so that they know which oil to use in the engine between oil changes.

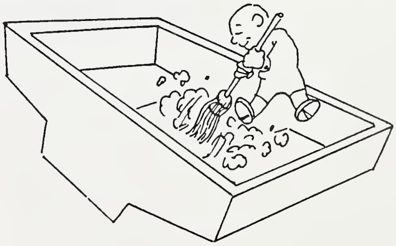
Motor oil performs the following functions:

- reducing friction
- cooling hot parts
- sealing between moving parts
- cushioning heavy loads
- cleaning parts.









VISCOSITY RATINGS

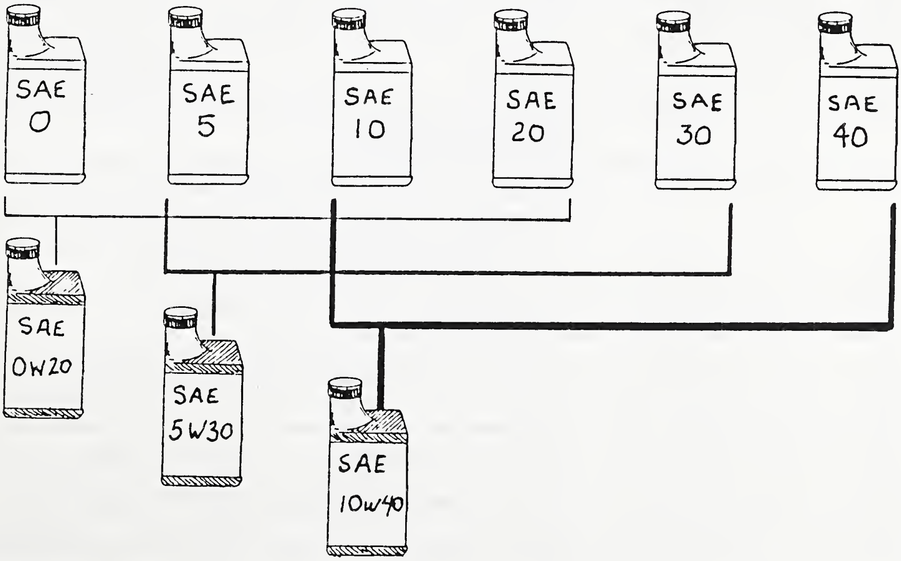
Motor oils are classified according to their VISCOSITY. **Viscosity means "resistance to flow".**

- A high viscosity oil resists flowing, is thicker, at higher temperatures.
- A low viscosity oil flows easier, is thinner, at lower temperatures.

Many years ago, oils came in only one viscosity rating or grade. This oil was very limited in its operating temperature range which meant that the vehicle owner had to be very careful that the oil in the engine was suitable for the outside temperature. MULTIGRADE OILS have now taken the place of single weight oils.

Multigrade oils have a much broader operating range. Multigrade oils are blended oils that work like a winter grade oil (shown by a 'W' such as in 10W) and summer oil (shown as 30). This produces a multigrade oil of 10W-30.

Viscosity ratings are set by the Society of Automotive Engineers (SAE). The SAE coding system of numbers and letters is used on all oil containers to indicate viscosity. With the ongoing changes in engine design and oil formulation, the automotive service employee should always select a viscosity according to the engine manufacturer's recommendations.



API SERVICE RATINGS

Motor oils are also classified according to an API SERVICE RATING. API stands for the "American Petroleum Institute". The different ratings mean that the oils will withstand the stresses and strains placed on them according to the tests done for that particular service rating. MORE THAN ANYTHING ELSE, THIS SERVICE RATING IS THE MOST IMPORTANT THING THAT A SERVICE PERSON MUST KNOW ABOUT OILS.

API service ratings are given as a two-letter code.

- The first letter indicates the type of fuel used in the engine. One of two possible letters are used, either an "S" for gasoline or a "C" for diesel fuel.

- The second letter indicates the severity of the engine operating conditions the oil must withstand. These conditions may be given according to a manufacturing date. Remember, newer vehicles run hotter, faster, and are harder on oils. Also, special oil features are included in the second letter of the code.

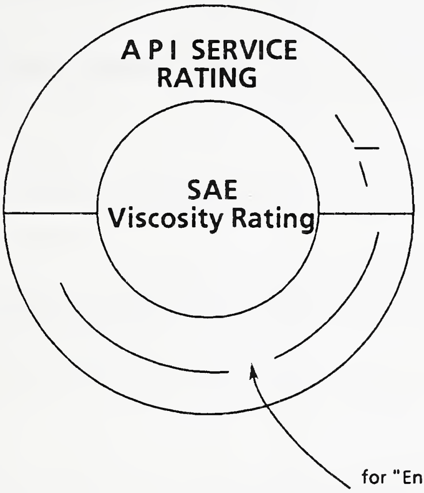
The following chart explains current API service codes. Remember that each new oil has the quality of the last oil and provides new qualities.

API Service Code	Fuel Type	Operating Conditions Special Oil Features
SA	Gasoline	Mild conditions, no additives (Mineral Oil)
SB	Gasoline	Light duty, some protection from scuffing and rusting
SC	Gasoline	1964 to 1967 warranty requirements, controls sludge deposits.
SD	Gasoline	1968 and later warranty requirements, improved deposit and rusting control
SE	Gasoline	1972 and later warranty requirements, improved protection especially against high temperature deposits
SF	Gasoline	1980 and later warranty requirements
SG	Gasoline	1987 and later warranty requirements
CA	Diesel Fuel	Light duty operation without a supercharger
CB	Diesel Fuel	Medium duty operation without a supercharger
CC	Diesel Fuel	Medium duty operation with a supercharger
CD	Diesel Fuel	Heavy duty operation with a supercharger
CE	Diesel Fuel	Heavy duty operation with a supercharger on engines built after 1983

THE API DONUT

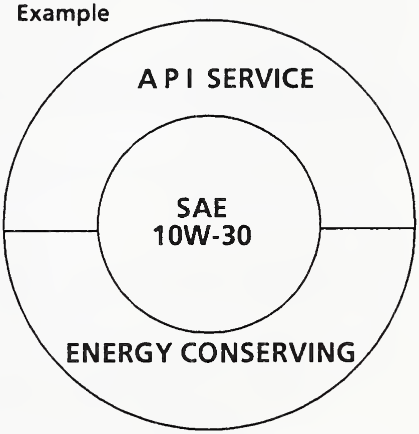
The API has developed a "donut" that contains information about the oil. All oil cans have this donut.

Study the picture of the donut below and identify each feature of the oil.



for "Energy Conserving" designation

Example



STUDENT ACTIVITIES

1. Select a container of motor oil in the shop and answer the following questions.

   - What is the API service classification of the oil?

     ____

   - What is the viscosity rating of the oil?

     ____

   - In what type of vehicle could this oil be used?

     ____

2. Visit a local auto parts store and identify at least six different brands of motor oil. Report the brand name, service rating and viscosity on the chart below.

	Brand	Viscosity Index	Service Rating
1.			
2.			
3.			
4.			
5.			
6.			

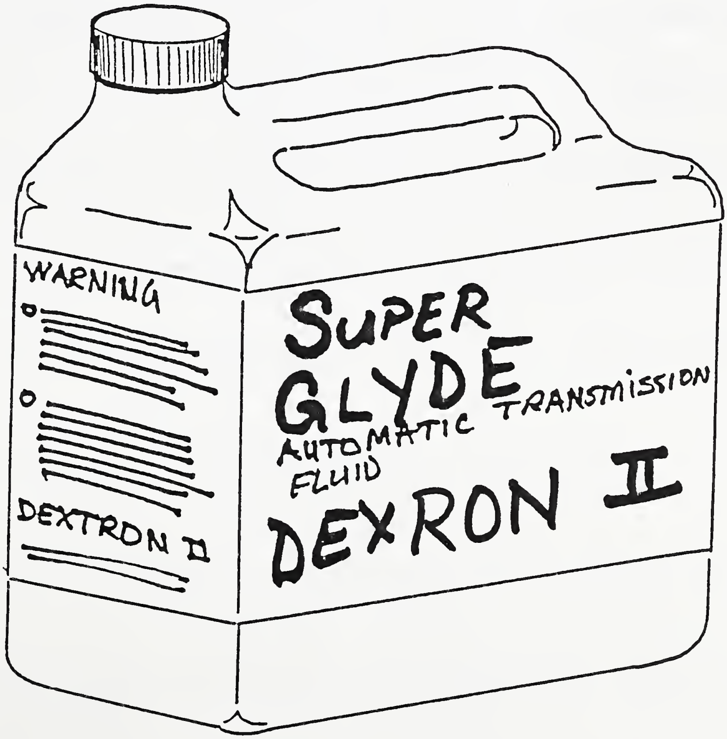
AUTOMATIC TRANSMISSION FLUID

Many vehicles on the road today use an automatic transmission to shift gears. There is a special liquid called 'AUTOMATIC TRANSMISSION FLUID' (ATF) inside the transmission. This fluid acts as a lubricant and pressure applicator. The level of the ATF should be checked at each fill-up and topped up if necessary.

There are three kinds of ATF:

- Type F
- DEXRON and DEXRON II
- Type CJ

CAUTION: NEVER mix transmission fluids. Putting the wrong fluid into a transmission will destroy the transmission.



STUDENT ACTIVITIES

1. Using shop manuals or transmission fluid application charts, identify the type of ATF needed by each of the following vehicles.

VEHICLE	ATF NEEDED
1990 Chevrolet Caprice	
1988 Ford Mustang	
1983 Chrysler Laser	
1979 Dodge Aspen	
1986 Toyota Corolla	
1990 Nissan 300 ZX	
1981 Mercury Zephyr	
1975 Jeep Wagoneer	
1989 Mazda 626	
1991 Chevrolet Corvette	

ADDITIVES

Anyone working in a gas station or car dealership may be asked by a customer about additives. Each additive is designed to help improve the vehicle's operation in some way.

STUDENT ACTIVITIES

1. Brainstorm: "What do oil additives do?"

   ____

   ____

   ____

2. a. Invite a journeyman auto mechanic or an auto parts and sales person to class. Ask them to explain the purpose and benefits of various oil additives.

   b. Complete the following chart.

Type of Additive	Benefits

3. Visit the local auto parts store and examine some of the various additives they sell. Read the labels of each product and complete the table below.

Additive	Purpose

LUBRICATION SERVICE

Lubrication service refers to all tasks done to ensure proper lubrication to every part on the vehicle. Common lubrication tasks include:

- oil and filter changes
- chassis lubrication
- checking fluid levels.

Before performing these services, the employee should:

- understand the construction of the engine lubrication system
- recognize basic lubrication service tools
- understand the techniques and steps required to complete the task properly.

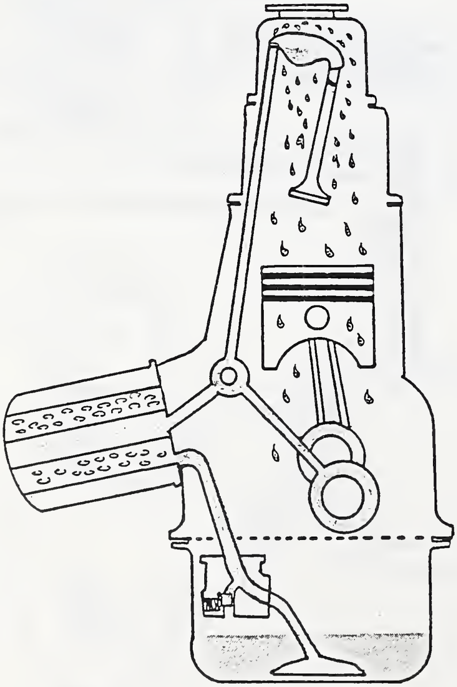
THE ENGINE LUBRICATION SYSTEM

The engine lubrication system is called upon to do the following:

- lubricate and reduce friction
- cool the engine
- seal between moving parts
- cushion heavy loads
- transmit pressure to various parts
- reduce noise.

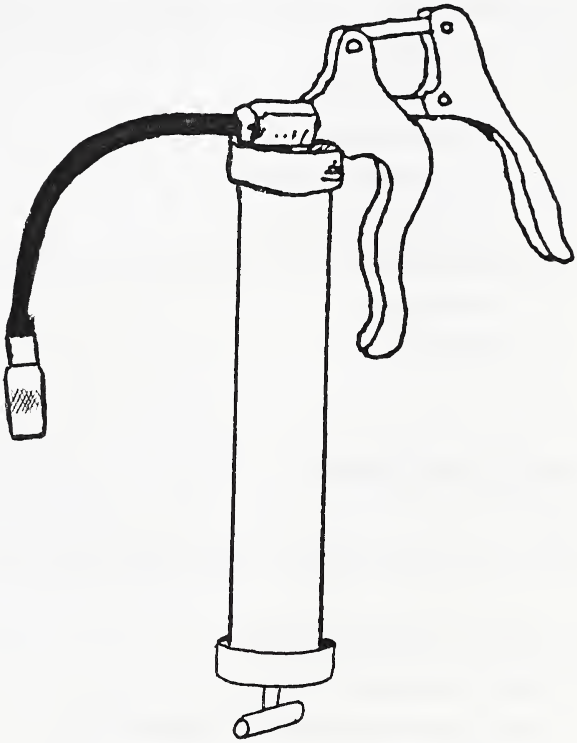
Motor oil is supplied under pressure to all parts of the engine and is stored in the **OIL PAN**. An **OIL PUMP** picks up the oil through an **OIL PICKUP** and then forces it through the **OIL FILTER** where the dirt is removed. From there, the oil flows through **OIL GALLERIES** to the various areas inside the engine.

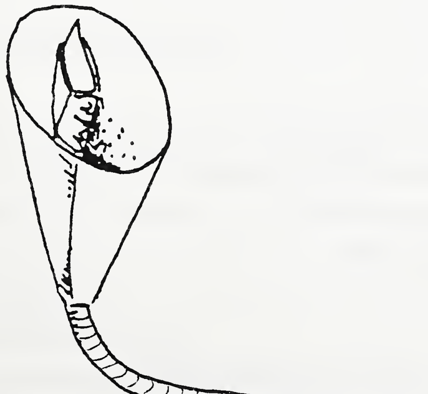
Study the following illustration of an engine lubrication system. Remember that not all engine designs are the same; pieces may look different and may be in different places. However, the same parts are found in all engines.



LUBRICATION SERVICE TOOLS

The tools shown below are those commonly used for oil changes and grease jobs.





STUDENT ACTIVITIES

1. Using equipment and tool catalogues, identify the items on the preceding page. Use the names from the following list to help identify the items.

   - oil funnel
   - ATF funnel
   - oil drain mobile
   - oil filter wrench
   - low pressure grease gun
   - high pressure grease gun
   - trouble light
   - suction gun
   - oil spout.

SERVICE PROCEDURES

Common service procedures included in this section are:

- engine oil and filter changes
- chassis lubrication
- checking standard transmission gear oil levels
- checking automatic transmission fluid levels
- checking rear axle assembly gear oil levels.

ENGINE OIL AND FILTER CHANGES

Engine oil needs to be changed regularly. The frequency of this change will depend on:

- the distance the vehicle was driven since the last change
- the type of driving
- the outside temperature
- the loads that the engine carries (e.g., pulling a trailer or other heavy load).

A good rule of thumb is that oil should be changed at the intervals given in the operator's manual, or at least every 6000 km. Canadian conditions are very harsh, and the "severe conditions" chart must be used. Some of the newer vehicles have a "maintenance light" which comes on when the oil needs to be changed. Information to activate this light is sensed by various engine and odometer inputs.

Of all the tasks that an automotive service person will be asked to do, this is one of the easiest, yet one of the most costly to the vehicle owner if it is not done correctly.

STUDENT ACTIVITIES

1. Study two different operator's manuals and list the oil change intervals recommended by the manufacturer.

   a. Vehicle Description ______________________________

   ____

   Recommended Interval ______________________________

   ____

   b. Vehicle Description ______________________________

   ____

   Recommended Interval ______________________________

   ____

CHASSIS LUBRICATION SERVICES

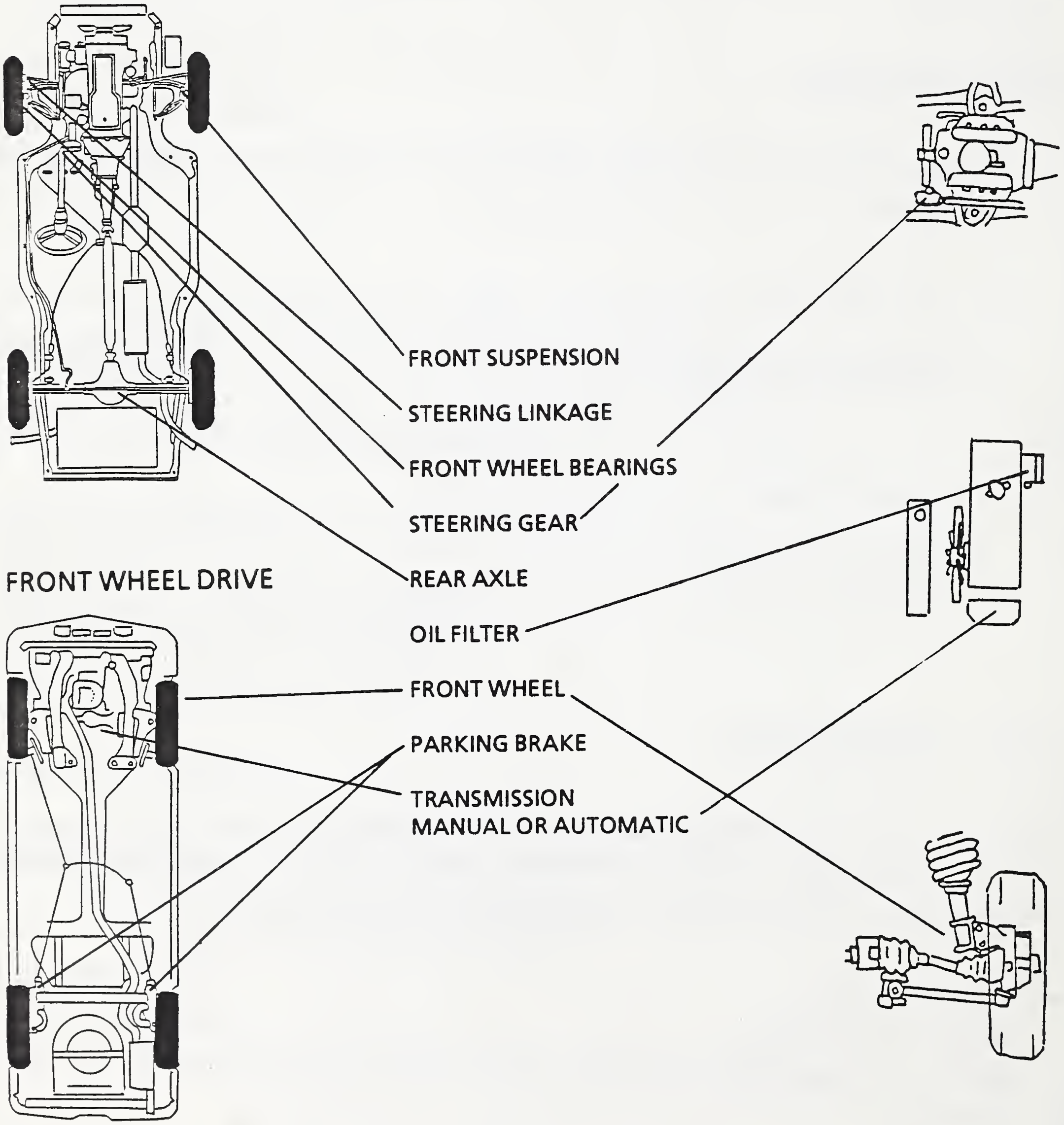
The chassis consists of the frame, steering, suspension and drive train. The chassis needs lubrication to maintain it in good order. Today's vehicles need less lubrication service work because some parts are 'lubricated for life'. However, many vehicles still need the following services:

- chassis lubrication
- standard transmission oil
- automatic transmission oil
- differential oil.

Job Sheets 14 through 18 show how these inspection services and top-ups are performed.

Many service manuals have charts, like the one below, showing where to lubricate the vehicle and which lubricants to use.

AREAS OF A VEHICLE THAT ARE LUBRICATED



JOB SHEET 14

CHANGING THE ENGINE OIL AND FILTER

EQUIPMENT, TOOLS AND SUPPLIES

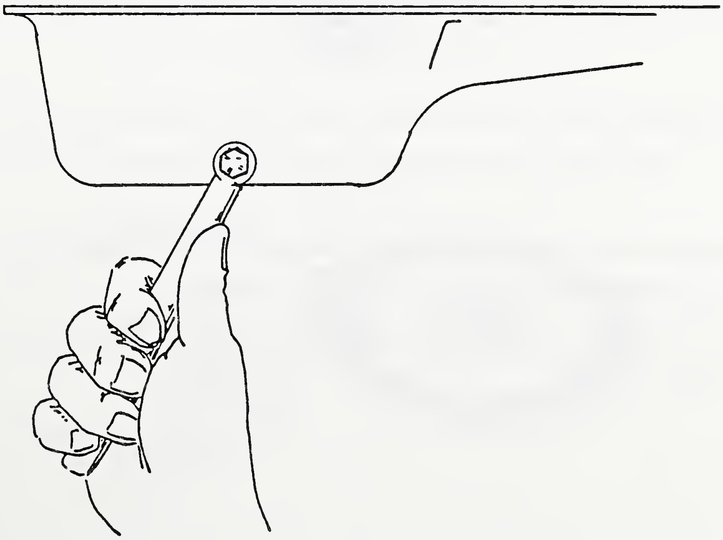
- Vehicle on a hoist
- Oil drainmobile
- Wrench (to fit)
- Oil filter wrench
- Fender covers
- Oil filter chart
- Oil filter
- Oil change sticker
- Motor oil

PROCEDURE

1. Open the hood of the car and place fender covers over the front fenders.

2. Raise the vehicle on the hoist and set the drainmobile under the oil pan.

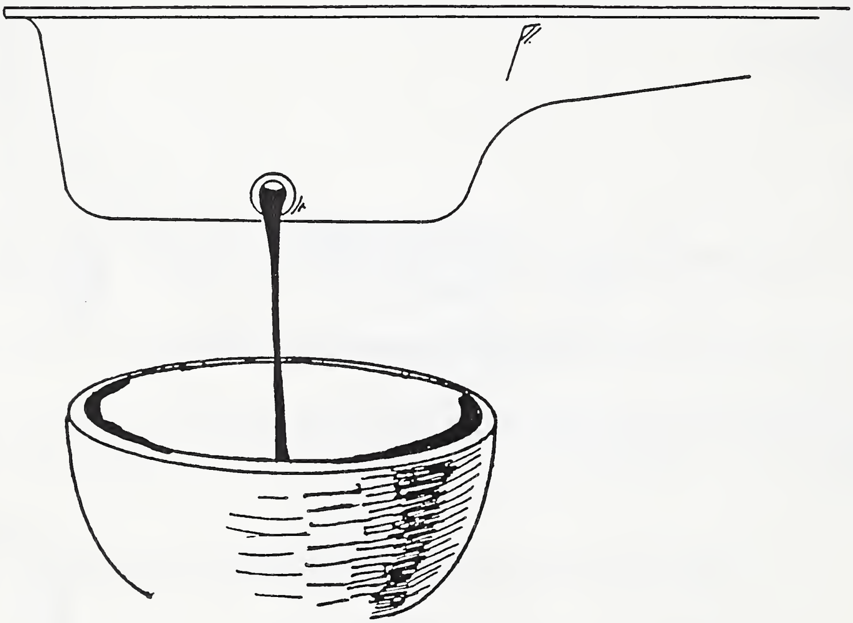
3. Using a 6-point box wrench, loosen the oil drain plug by pulling counterclockwise on the wrench.



4. Once the plug is loose, turn it the rest of the way by hand.

   Note: Be careful, the oil will come gushing out and it may be hot. Be prepared to catch the drain plug and move the drainmobile into the right spot. Don't drop the drain plug into the drainmobile.

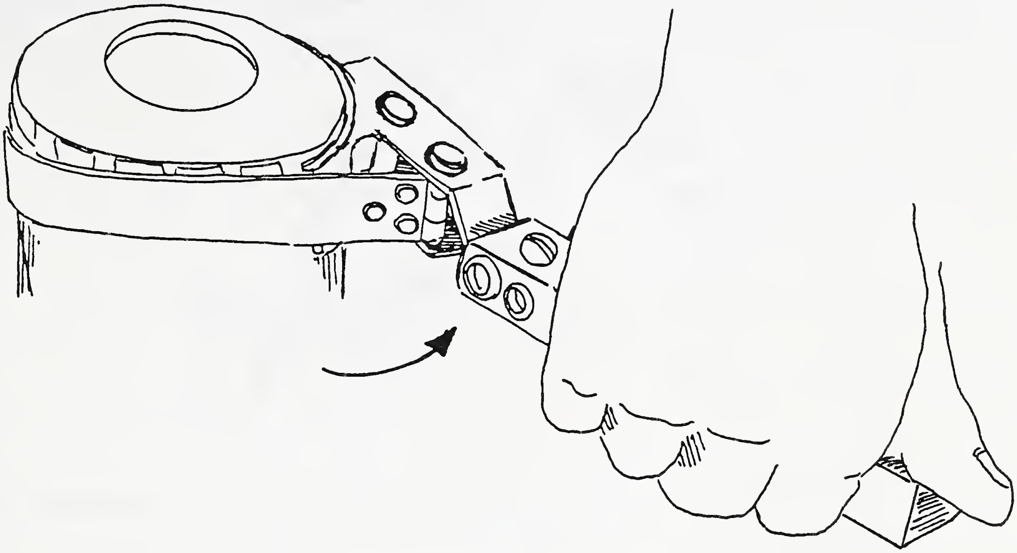
5. Allow the oil to run out. Check the washer on the drain plug to see that it is in good condition. Replace the washer if necessary.



6. Install the drain plug with the washer by hand. Turn it in at least three turns by hand before tightening it up with the wrench.

   Note: Do not overtighten the drain plug because the threads may strip and cause leaks or total oil loss.

7. Using the oil filter wrench, loosen the oil filter by turning it counterclockwise.

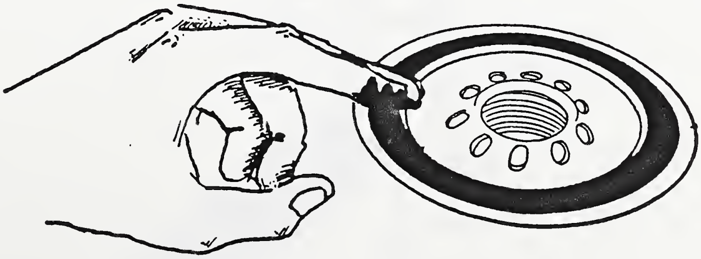


8. Place the drainmobile under the oil filter and, being careful not to burn yourself, carefully remove the oil filter.

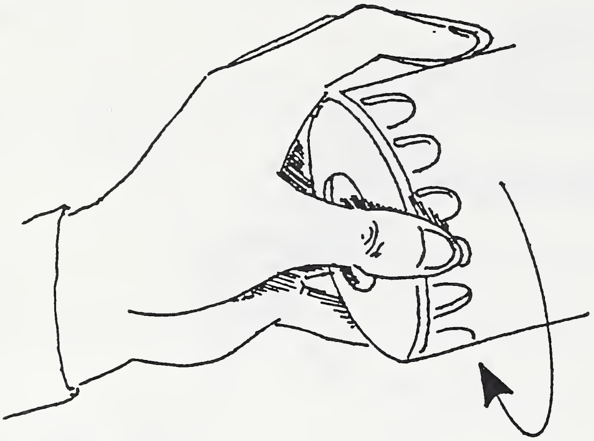
   Note: Some oil filters will have to be removed from the top of the vehicle rather than from underneath it.

9. Use the oil filter chart to find the correct oil filter for the vehicle's engine. Select the correct oil filter.

10. Spread a drop of clean motor oil over the rubber gasket on the new oil filter before installing it. The oil will prevent the new filter from sticking too tightly when it is removed.



11. Screw the new filter on by hand. Once it seals, tighten the filter by hand the recommended number of turns (1/2 to 1 1/2 turns).



Note: Do not overtighten the filter or use a filter wrench.

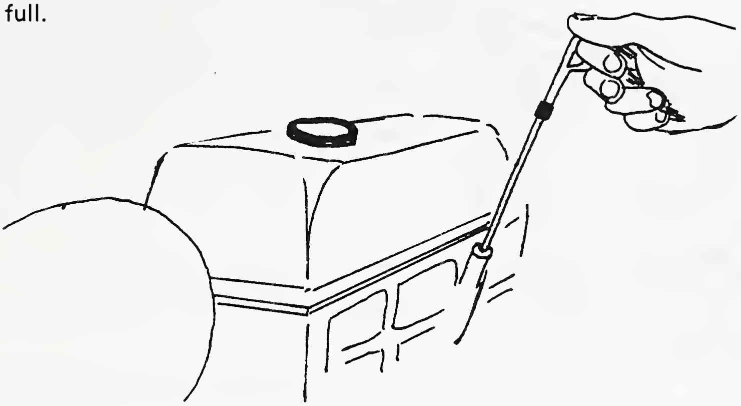
12. Lower the car. Remove the oil filter cap.

13. Place the oil funnel in the hole in the valve cover.

14. Pour the recommended amount of the recommended, clean motor oil into the engine.

15. Wait two minutes for the oil to flow into the oil pan.

16. After the oil is in the engine, pull out the oil dipstick, wipe it dry and replace it. Pull it out again and check the oil level. It should read FULL. If not, add more oil and recheck until the level shows full.



17. Replace the dipstick.

18. With the teacher/supervisor's permission, start the engine.

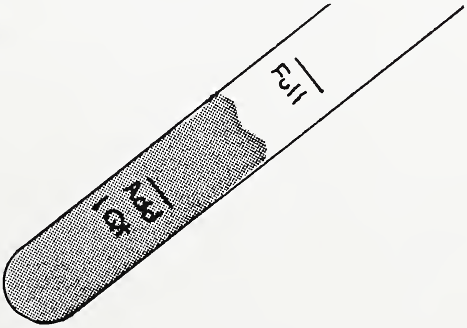
    Note 1: Watch the oil pressure light. It should turn off in about five seconds after the engine is started.

    Note 2: If the light does not go out, shut the engine off immediately and check under the car for an oil leak.

19. Check under the engine for leaks.

20. Shut off the engine.

21. Check the oil level again with the dipstick and, if necessary, top the oil up to the full line of the dipstick.



22. Fill out the engine oil change sticker according to the teacher's or supervisor's directions and stick it onto the door pillar as illustrated.

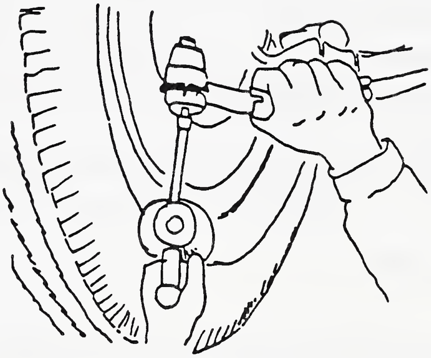
23. Clean and return all equipment, tools and supplies to their proper storage areas.

24. Clean up the work area.

JOB SHEET 15
LUBRICATING AN AUTOMOBILE CHASSIS

EQUIPMENT, TOOLS AND SUPPLIES

- Vehicle
- Hoist
- Grease gun
- Rag



PROCEDURE

1. Support the vehicle on a hoist or jack stands.

2. Wipe off the ends of the grease fittings.

3. With a low pressure grease gun, apply two or three pumps of chassis grease to the following points:
   - upper and lower ball joints
   - center link joints and tie rod ends
   - upper and lower control arm pivots
   - idler arm and pitman arm.

   Note: Do not overgrease the joints. Too much grease will cause the dust boot to pop out.

4. Lower the vehicle.

5. Wipe up any spilled grease.

6. Clean and return all equipment, tools and supplies to their proper storage areas.

7. Clean up the work area.

JOB SHEET 16

CHECKING THE STANDARD TRANSMISSION OIL LEVEL

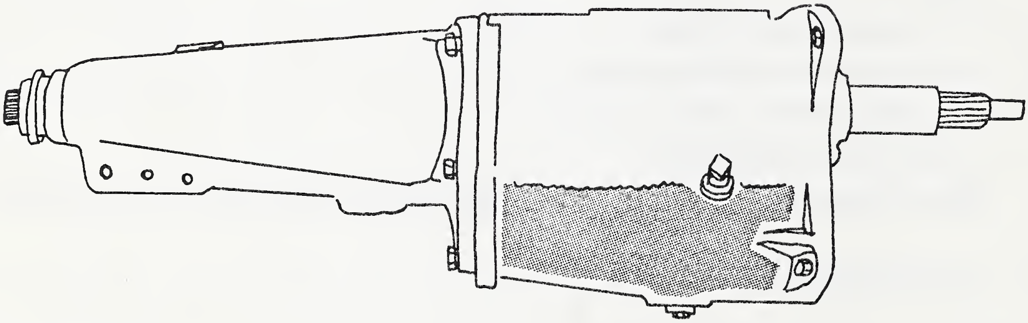
EQUIPMENT, TOOLS AND SUPPLIES

- Vehicle on a hoist
- Suction gun
- Recommended gear oil
- Wrench
- Rag

PROCEDURE

1. Clean off the area around the transmission filler plug.

2. Remove the plug. Insert a finger in the hole to test the level. The oil should be just below the filler plug hole.



3. If the level is low, fill the transmission with recommended gear oil.

4. Wipe up any spilled oil.

5. Clean and return all equipment, tools and supplies to their proper storage areas.

6. Clean up the work area.

JOB SHEET 17
CHECKING THE ATF LEVEL

EQUIPMENT, TOOLS AND SUPPLIES

- Vehicle
- Rag
- Recommended ATF

PROCEDURE

Note 1: The automatic transmission should be at operating temperature in order to check the level.

Note 2: To carry out this task, an exhaust pickup hose must be attached to the tail pipe.

1. Apply the brakes.

2. Start the engine.

3. Put the transmission through all the ranges to fill all the transmission passages.

4. Put the transmission into PARK.

5. With the engine running at idle speed, pull out the transmission dipstick.

6. Wipe it clean and return it into the dipstick tube.

7. Pull out the dipstick again and check the fluid level.
   Note: If the oil smells burnt or rancid, notify your teacher or supervisor.

8. Add the correct ATF if the fluid level is below FULL.

9. Clean and return all equipment, tools and supplies to their proper storage areas.

10. Clean up the work area.

JOB SHEET 18

CHECKING THE REAR AXLE ASSEMBLY OIL LEVEL

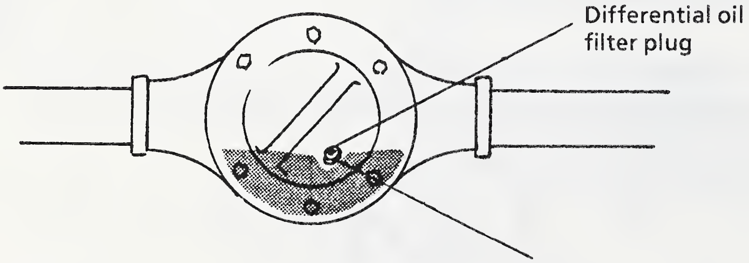
EQUIPMENT, TOOLS AND SUPPLIES

- Vehicle on a hoist
- Wrench
- Rag
- Gear oil

PROCEDURE

1. Clean the area around the differential filler plug.

2. Remove the plug. Insert a finger in the hole to test the oil level. The oil should be just below the filler plug hole.



Rear axle housing

3. If the level is low, fill the differential with the recommended hypoid gear oil.

4. Wipe up any spilled oil.

5. Clean and return all equipment, tools and supplies to their proper storage areas.

6. Clean up the work area.

COOLING SYSTEM SERVICE

THE COOLING SYSTEM

The engine generates a large amount of heat when running. This heat must be controlled in order for the engine to operate efficiently and to prevent part damage. The cooling system is designed to:

- remove any excess heat
- maintain the proper operating temperature
- promote a fast warm-up on cold starts
- supply hot water or hot air for the vehicle's heating system.

COOLING SYSTEM PARTS

The most common system used is the liquid cooling system. The liquid used is a mixture of water and an antifreeze concentrate called ETHYLENE GLYCOL. This mixture is called the COOLANT.

The coolant is stored in the RADIATOR, ENGINE WATER JACKETS and the various HOSES.

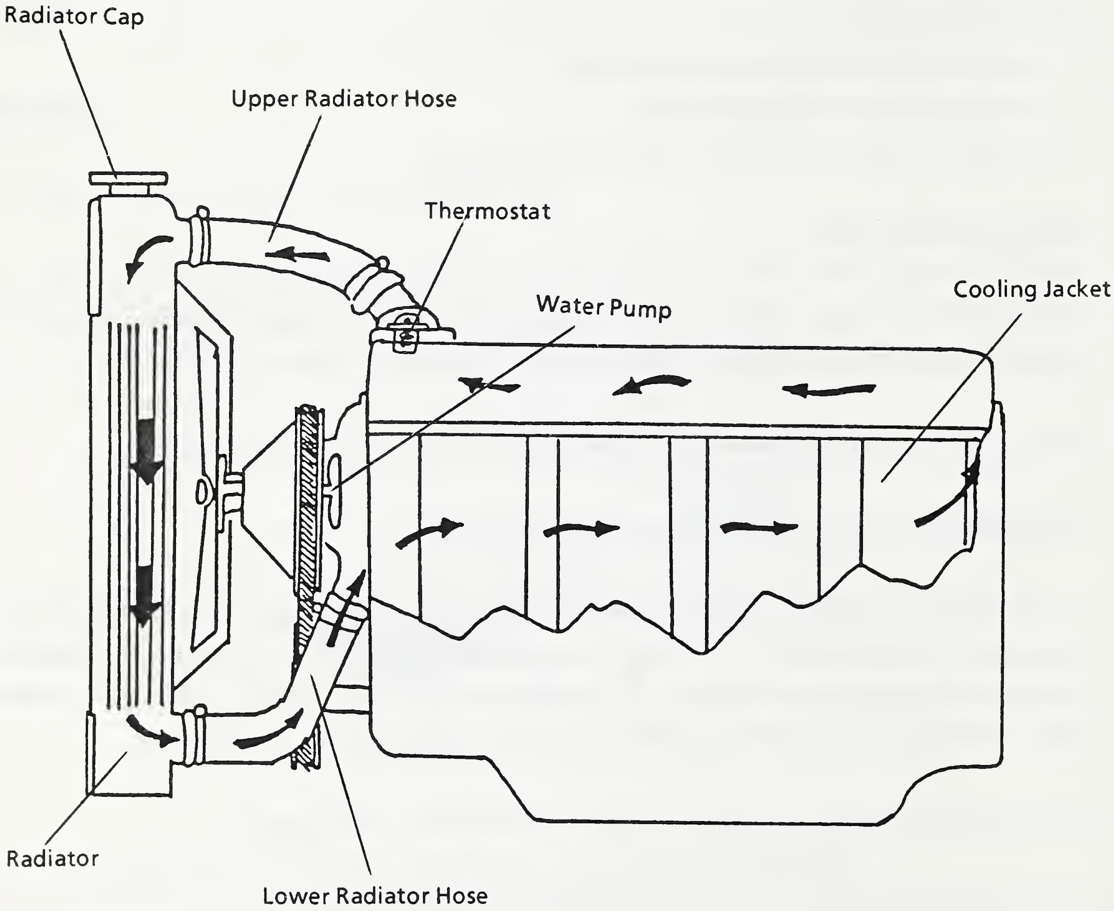
A WATER PUMP forces the coolant through the cooling system.

A THERMOSTAT prevents the coolant from circulating to the radiator when the engine is cold and monitors the flow of coolant to the radiator when the engine is hot. This action keeps the coolant at just the right temperature for the engine to operate correctly. The coolant goes through the UPPER RADIATOR HOSE to the radiator when the coolant is hot enough to open the thermostat.

A FAN pulls air through the radiator to reduce the temperature of the coolant.

The cooling system runs in a cycle. That is, coolant is circulated through the system to maintain a safe temperature while the engine is running.

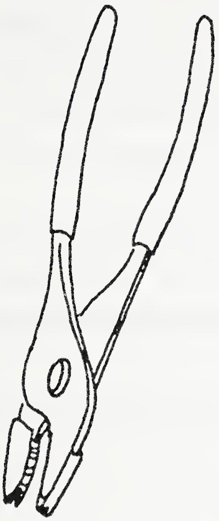
The illustration below shows the parts used in a cooling system. Not all engines are the same, and parts may look different or be in different places. However, the same basic parts are used in the liquid cooling systems of all engines.

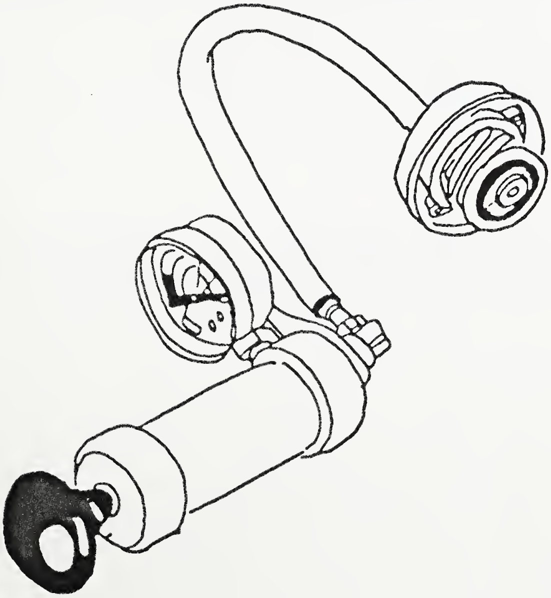


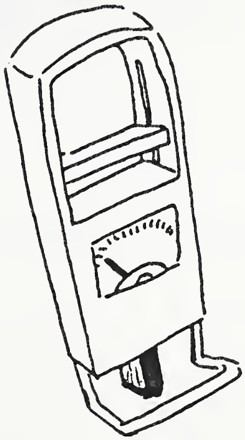
COOLING SYSTEM PARTS

COOLING SERVICE TOOLS

The equipment and tools shown in the diagram below are some of the most common cooling service tools.







STUDENT ACTIVITIES

1. Using equipment and tool catalogues, identify each of the cooling service tools on the previous page. Use the following list of names to help you identify the items:

   - cooling system pressure tester
   - antifreeze tester
   - cooling system power flusher
   - hose slitter
   - strand tension gauge.

SERVICE PROCEDURES

The cooling system must be kept in good working order to function correctly. The following jobs are performed by auto service employees:

- adjusting fan belts
- replacing fan belts
- checking antifreeze strength
- adjusting antifreeze strength
- replacing radiator hoses.

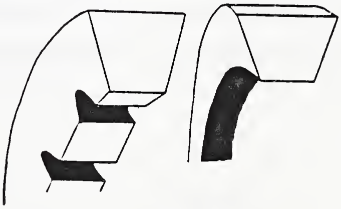
FAN BELT SERVICE

The engine does more than just provide the power to drive a vehicle down the road. The turning crankshaft drives other equipment including:

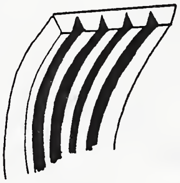
- water pump
- fan
- alternator
- power steering pump
- air conditioning compressor
- air injection pump.

Fan belts are used to drive the above listed items. If a belt starts to wear and slip, it will not drive the unit fast enough. It will also start to squeal loudly and damage the pulley surfaces. There are two main types of automotive fan belts.

The belts are usually in a **V-belt** design.



Many newer cars and trucks use a flat **serpentine belt**.



To adjust these serpentine belts, check the vehicle manual for the correct procedure. These belts require special procedures. Job Sheets 19 and 20 cover "V-belt" Service.

JOB SHEET 19
ADJUSTING A FAN BELT

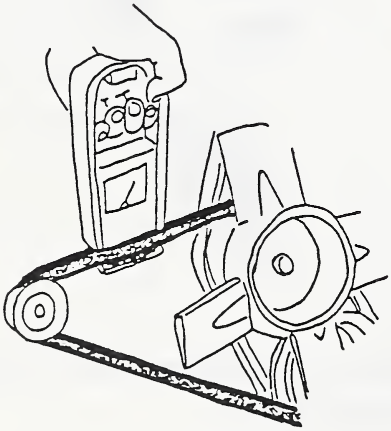
EQUIPMENT, TOOLS AND SUPPLIES

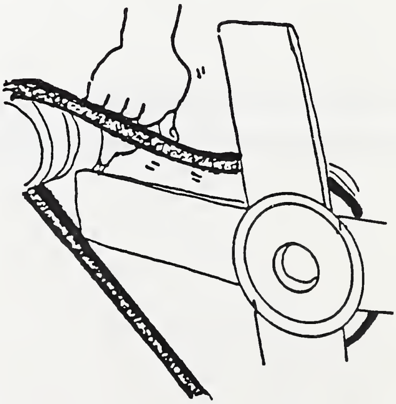
- Vehicle
- Strand tension gauge (if available)
- Wrenches
- Sockets and handles
- Pry bar

PROCEDURE

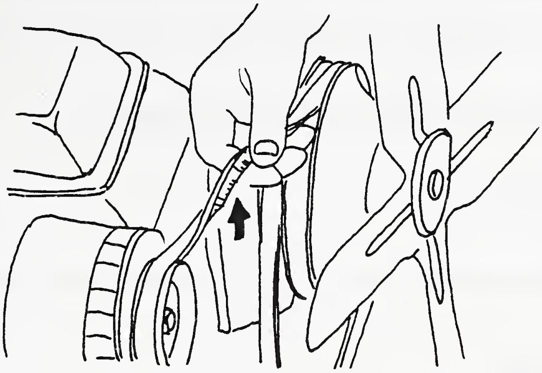
1. Shut off the ignition and place the keys on the dashboard surface.

2. Check the fan belt tension. This should be done using a strand tension gauge. If you do not have a gauge, press down on the centre of a belt span with your thumb. The belt should "give" between 1.2 mm and 2.5 mm when moderate pressure is applied.



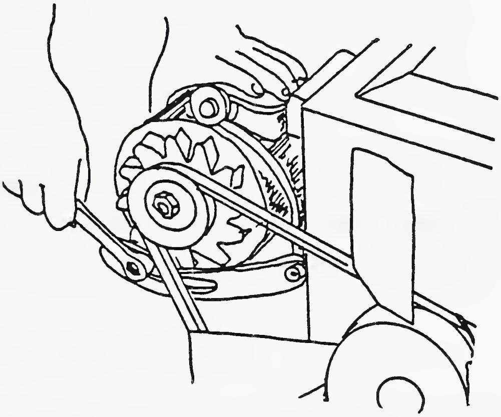


3. Check the belt condition. Roll the belt between your fingers and look underneath it. If it is frayed or cracked the belt must be replaced, otherwise it could soon disintegrate. See Job Sheet 20 for belt replacement procedures.



4. Identify the accessories that need to be moved in order to tighten the belt.

5. Using the correct wrenches, loosen all the necessary fasteners.



6. Pry in a safe spot until the belt is retensioned.

   Note 1: Many accessories now have special square holes where a mechanic may use a flex handle to move the accessory.

   Note 2: DO NOT PRY ON THE POWER STEERING PUMP BODY.

   Note 3: Check with the teacher or supervisor before attempting to pry or pull on an accessory.

7. Hold the parts in place and tighten all of the fasteners again.

8. Recheck the belt tension.

9. Clean and return all equipment, tools and supplies to their proper storage areas.

10. Clean up the work area.

JOB SHEET 20

REPLACING A FAN BELT

EQUIPMENT, TOOLS AND SUPPLIES

- Wrenches
- Socket set
- Pry bar
- Fan belt

PROCEDURE

CAUTION

- Remove the key from the ignition to prevent anyone from starting the engine when you have your fingers in the fan area.
- Some fan blades are sharp and can cause severe cuts.
- Take care not to pinch fingers under the belt during installation.

1. Raise the vehicle's hood.

2. Inspect the belts for cracks, glazing or tears.

3. If one belt is in poor condition inspect the rest of the belts.

   Note: A replacement of all belts may be required so that the customer does not have to come back in a few months to have another belt replaced.

4. Loosen the parts that need to be shifted.

5. Remove the belts, keeping them in order so that the new ones can be replaced in the same order.

6. Select the new belts, checking that they are the correct sizes.

7. Install the new belts in the right order over the pulleys.

8. Tension the belts as required.

9. Check the tightness of all fasteners.

10. Clean and return all equipment, tools and supplies to their proper storage areas.

11. Clean up the work area.

TESTING ANTIFREEZE

Radiator antifreeze, or COOLANT, must be strong enough to prevent the cooling system from freezing up in cold weather. For most regions of Alberta, the freezing point of the coolant must be at –40° C.

In the summer, the cooling system should contain antifreeze, too. The antifreeze will raise the boiling point of the coolant. Thus the engine will not overheat as easily. The antifreeze also stops the metal engine parts from rusting.

JOB SHEET 21
TESTING ANTIFREEZE STRENGTH

EQUIPMENT, TOOLS AND SUPPLIES

- Antifreeze tester (hydrometer)
- Vehicle
- Rags
- Eye protection
- Vinyl gloves

PROCEDURE

CAUTION

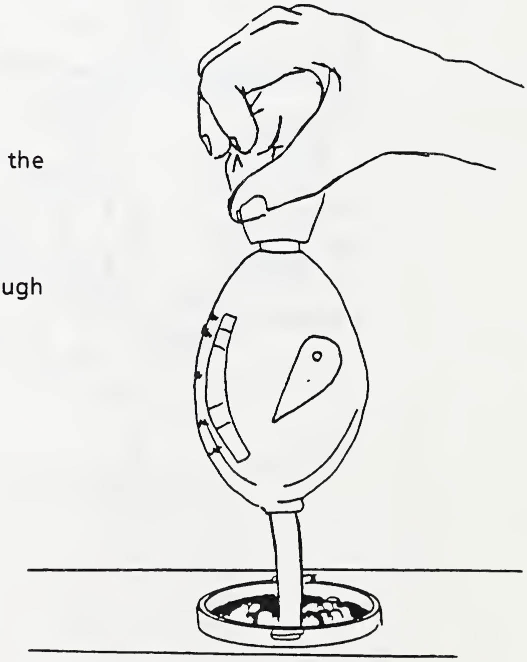
- This task is to be performed on a cold engine.
- Keep coolant away from your skin and eyes.
- Keep coolant away from animals. The coolant is very poisonous. A teaspoon of coolant will kill a small dog or cat.

1. Put on the eye and hand protection.

2. Remove the radiator cap.

3. Insert the rubber hose of the tester into the filler neck.

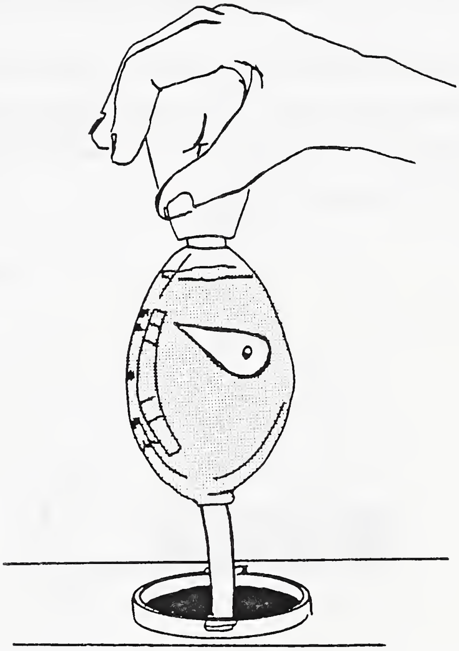
4. Squeeze the tester bulb and draw up enough coolant to fill the chamber to the full line.



5. Hold the hose upright so that the coolant does not leak out.

6. Hold the tester so that the tester level line and the coolant level are parallel with each other.

7. Read the coolant freezing temperature, next to the pointer on the indicator.



8. Put the hose back into the radiator and empty the tester.

   Note: If the antifreeze is of insufficient strength, notify your teacher or supervisor. Strengthening the antifreeze will involve draining some coolant and replacing it with full strength antifreeze concentrate as directed.

9. Reinstall the radiator cap.

10. Clean and return all equipment, tools and supplies to their proper storage areas.

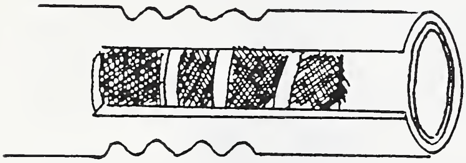
11. Clean up the work area.

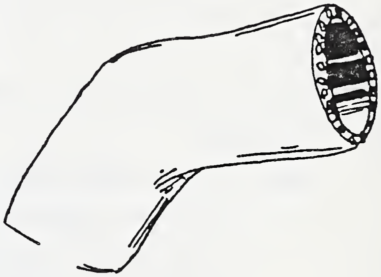
RADIATOR HOSES

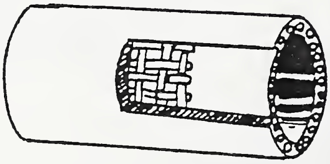
Radiator hoses are used to transport the coolant from the engine to the radiator (upper radiator hose) and to bring the coolant back to the engine from the radiator (lower radiator hose).

There are other rubber hoses that transport the coolant to and from the heater core. These hoses are called **heater hoses**. Some engines also have a small **bypass hose** which lets coolant flow around the closed engine thermostat. The coolant can go from the cylinder head back down to the water pump when the engine is cold.

TYPES OF HOSES





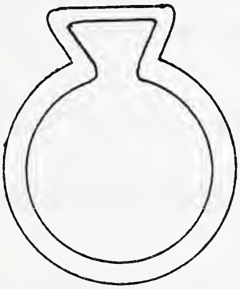


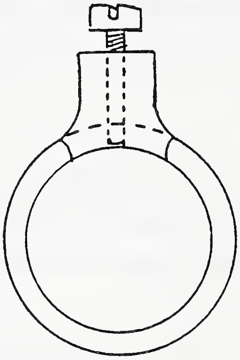
Hoses are subjected to heat and chemicals. They should be checked regularly and replaced as necessary. All coolant hoses may be replaced using the same basic procedure as the upper radiator hose replacement covered in Job Sheet 22.

Hose Clamps

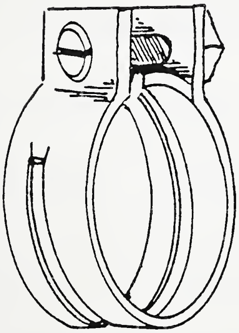
Radiator and heater hoses are fastened onto the engine and radiator with hose clamps. These hose clamps come in several different types and shapes. Some are reuseable, others are not.

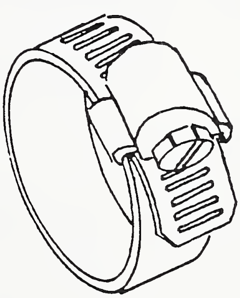
NON-REUSEABLE HOSE CLAMPS

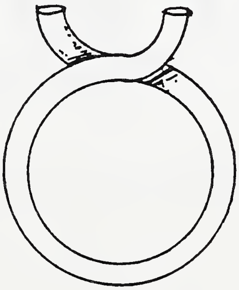




REUSEABLE HOSE CLAMPS







JOB SHEET 22

REPLACING AN UPPER RADIATOR HOSE

EQUIPMENT, TOOLS AND SUPPLIES

- Eye protection
- Vinyl gloves
- Coolant drain pan
- Slip joint pliers
- Screwdrivers or hose clamp pliers

PROCEDURE

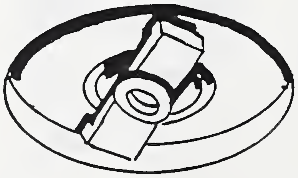
CAUTION

- This task is to be performed on a cold engine.
- Keep coolant away from your skin and eyes.
- Keep coolant away from animals. The coolant is very poisonous. A teaspoon of coolant will kill a small dog or cat.

1. Put on the eye and hand protection.

2. Set the drain pan under the drain plug of the radiator. Open the drain plug with the combination pliers.

   Note: The drain plug goes INTO the radiator even though you are turning it counterclockwise.



3. While the coolant is draining, loosen the two hose clamps on the upper radiator hose.

4. Once the two clamps are loose or out of the way, firmly grasp the upper radiator hose and try to twist it loose. This will release it from the radiator filler neck. If the hose sticks, get assistance from your teacher or supervisor.

5. Once both ends of the hose are loose, remove the hose from the car.

6. Clean the two areas where the hose fits (thermostat housing and upper radiator hose connection) with a cloth or emery paper. It is very important that these surfaces are clean, otherwise the new hose may leak.

7. Select the correct hose. Replace the hose clamps if necessary.

8. Install the loosened hose clamps on the hose.

9. Put the hose in place and securely tighten the clamps. Make sure that the screws or ends of the clamps are easy to get at and that they do not get caught in anything.

10. Close the drain plug. Pull the drain pan out from under the radiator and test the coolant strength. Adjust if necessary.

11. Fill the radiator with the coolant and replace the radiator cap.

12. Connect the tailpipe to an exhaust extraction system.

13. Start the car and check for coolant leaks.

14. Clean and return all equipment, tools and supplies to their proper storage areas.

15. Dispose of the old radiator hose as recommended.

16. Clean up the work area.

TIRE SERVICE

Vehicles are supported on air filled tires, of which there are many different brands and types. There are so many different kinds because of varying operating conditions and driver demands.

TIRE TYPES AND SIZES

Automotive employees must recognize different tire types and sizes because it affects tire service. Tire sidewalls provide the information needed to choose those tires best suited to a particular vehicle. Information found on the sidewalls includes:

INFORMATION	SIDEWALL EXAMPLE
Brand and Model	Goodtire, Road Sticker
Tire Code	P 195 R75/13
Tire Construction	Radial
Tread Design	All Season
Maximum Inflation Pressure	35 psi
Belt Plies	4 ply steel
Sidewall Plies	2 ply polyester

The tire code can be understood by breaking it into parts.

Example: Tire Code P195 R75/13

P – Tire Use – P for passenger car
195 – Section Width – 195 mm interior width
R – Tire Construction – R for radial
75 – Aspect Ratio – Height is 75% width
13 – Rim Size – 13 inch diameter rim.

TIRE CODES

The information on the sidewall of the tire is very important to the automotive mechanic because the tires must be matched to vehicle design standards.

There are two tire codes, the metric and the imperial. The metric tire code is the common code used on the tires of most Canadian automobiles.
Note: Rim diameter is still measured in inches for both tire codes.

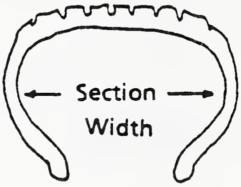
This code includes the following information:

- Tire Type

  P – passenger
  T – temporary
  C – commercial

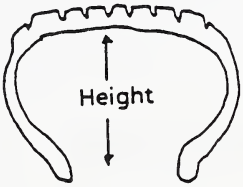
- Section Width in mm.

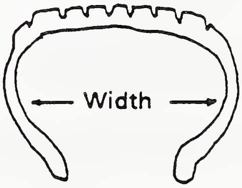
  175
  185
  195
  205
  215
  225



- Aspect Ratio (height/width) in %

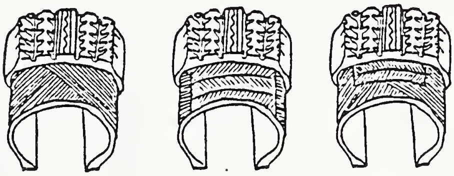
  60
  70
  75
  78





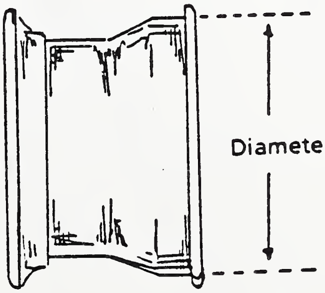
- Construction Type

  D – bias
  B – bias belted
  R – radial



- Rim Diameter

  12
  13
  14
  15
  16
  16.5



There are hundreds of different types and sizes of tires. However, for most vehicles, all four tires are the same. Check with your teacher or supervisor before mixing different tire types or sizes on a vehicle.

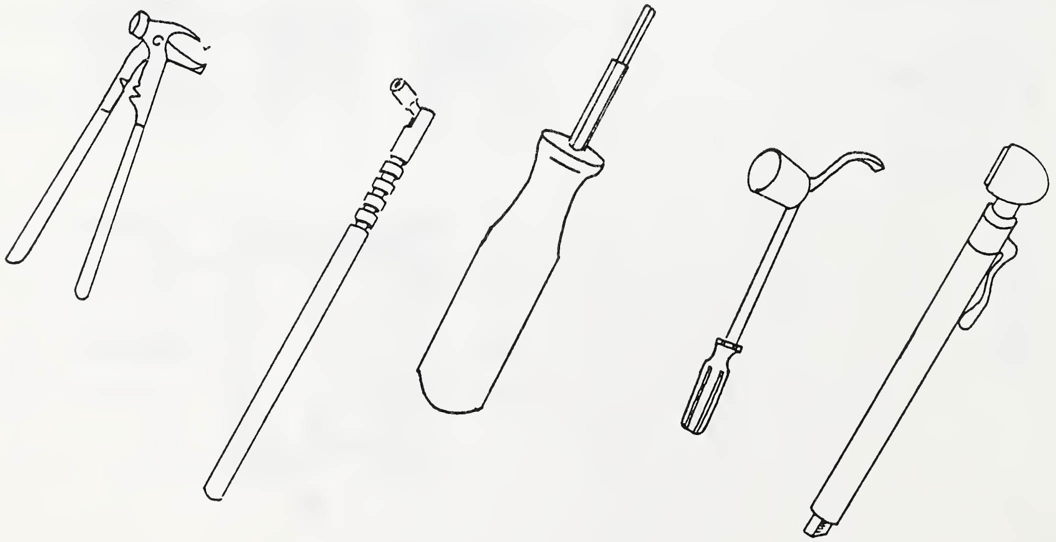
STUDENT ACTIVITIES

1. Explain what the following tire markings mean.

- C 225 R 70/16
- P 175 R 50/13
- P 205 R75 R15

TIRE SERVICE TOOLS

The following items are used in tire service tasks.



STUDENT ACTIVITIES

1. Using equipment and tool catalogues, identify the tire service tools on the previous page. Use the following list of names to help identify the items.

   - tire gauge
   - tire stitcher
   - tire tank
   - tire changer
   - tire balancer
   - wheel weight pliers
   - valve stem tool
   - air chuck.

SERVICE PROCEDURES

The basic tire service tasks covered in this section include:

- adjusting tire inflation
- removing and replacing tires
- balancing tires
- repairing tire leaks.

ADJUSTING TIRE INFLATION

Tire inflation refers to the air pressure inside the tire. The air supports the tire and allows the tire to flex. If the pressure is correct, the tire tread is forced flat against the road surface. Incorrect tire pressures cause the tire contact area to be reduced and will result in heat buildup and excessive wear.

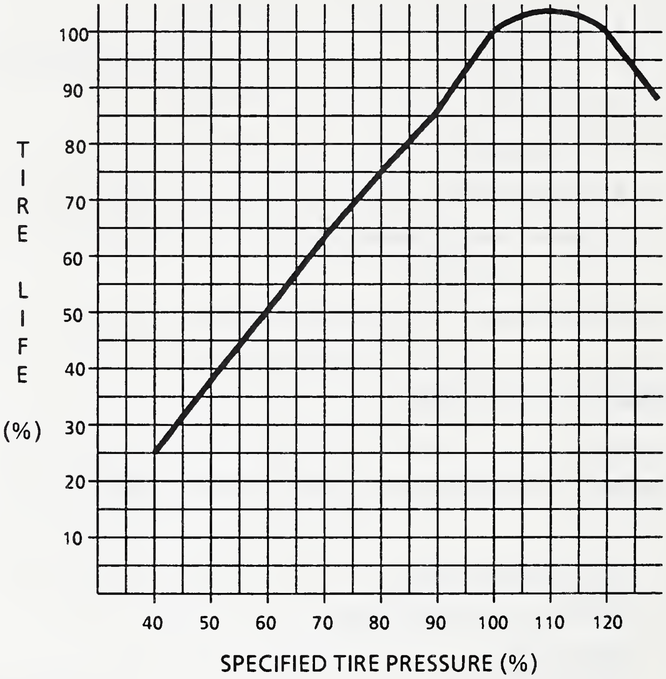
It is not uncommon to check the tire pressures and find that they are lower than specified. This causes poor handling and wear. The graph shows that at 50% inflation there is a loss of about 60% of tire life.

Tire inflation specifications are listed on a sticker in one of a number of places including:

- on the vehicle body
- on the door pillar
- on the glove box door.

The inflation may also be listed in the

- operator's manual
- shop reference.



Note: The pressure given on the side wall of the tire is a maximum pressure and should not be considered the normal inflation pressure.

STUDENT ACTIVITIES

1. Circle the portion of the graph line that shows the loss of tire life due to underinflation.

2. Complete the following chart.

% Tire Pressure	% Tire Life
50	
	75
130	

JOB SHEET 23
ADJUSTING TIRE PRESSURES

EQUIPMENT, TOOLS AND SUPPLIES

- Vehicle
- Tire pressure gauge
- Tire chuck
- Air hose
- Air supply

PROCEDURE

1. Identify the correct tire pressures for the tires being used.

2. Make sure the tires are cold (i.e., the vehicle has not recently been driven).

3. Remove the valve cap.

4. Hold the tire gauge and firmly press the chuck end against the valve stem of the tire. Adjust the angle of the gauge until no air leakage is heard. Recheck your reading to ensure accuracy.

5. Check and record the tire pressure of each tire.

	Right Front	Left Front	Right Rear	Left Rear	Spare
Specified Pressure					
Actual Pressure					

6. Adjust each tire's pressure to specifications by either:
   - pressing on the end of the valve core to release air (deflating the tire)
   - inflating the tire using the air line and tire chuck.

7. Reinstall the valve cap on each valve stem.

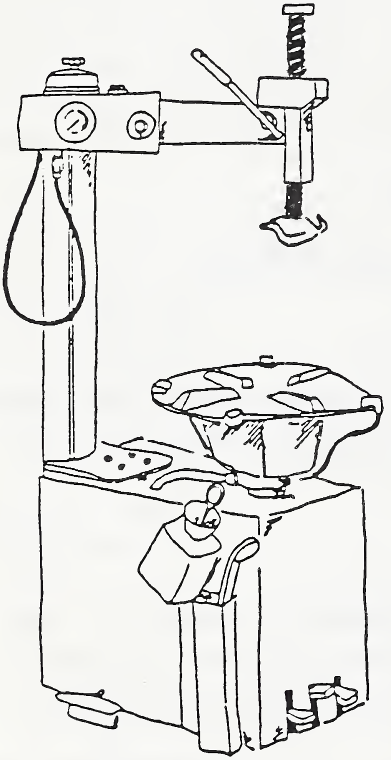
8. Clean and return all equipment, tools and supplies to their proper storage areas.

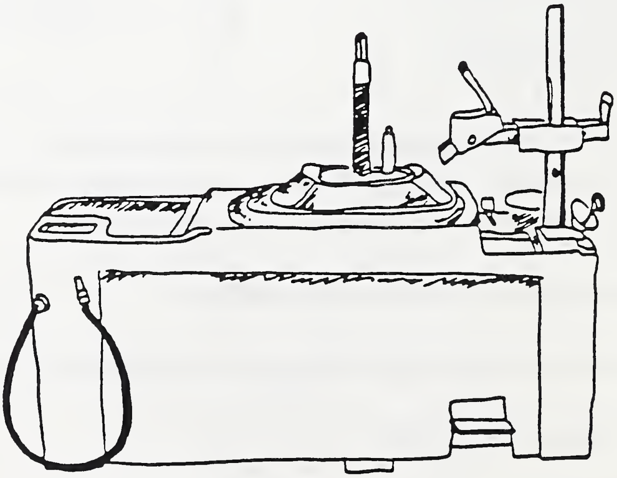
9. Clean up the work area.

CHANGING TIRES

One of the most important equipment items in many automotive shops is the tire changer. It is used by automotive service persons to remove and replace tires from the tire rim.

There are many different styles of machines. Some examples are shown below.





JOB SHEET 24
CHANGING TIRES

EQUIPMENT, TOOLS AND SUPPLIES

- Eye protection
- A tire on a rim
- Tire changer
- Tire lubricant
- Lubricant brush
- Replacement tire

PROCEDURE

CAUTION

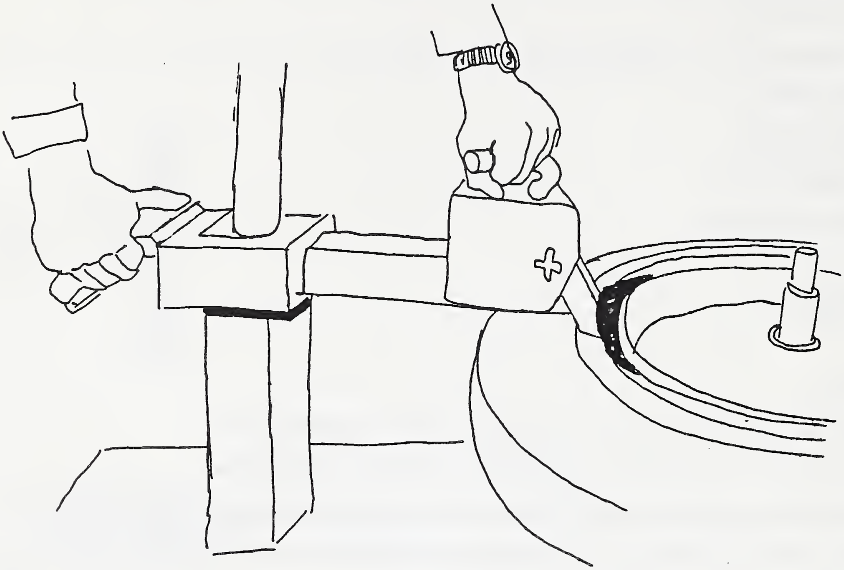
- Never press a pedal unless your hands are clear of moving parts.
- Never step on the inflator pedal without a tire on the machine.
- Never have your face close to the tire valve stem area when removing the valve core.
- Never use the tire changer for tires that do not fit the tire changing machine.

Note: This general procedure is designed for a common tire changer with a centre post. Always use the specific instructions for the changer to be used.

Removal

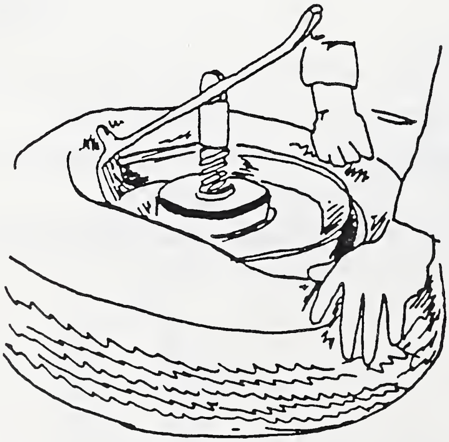
1. Put on the eye protection.
2. With the outside of the rim, the valve stem side up, mount the tire over the centre shaft .
3. Place the **rim locking pin** through one of the wheel nut holes.
4. Thread the centre locking collar (taper down) onto the wheel rim. Centre the rim and tighten the collar securely.
5. Remove the valve core using the valve core remover. **USE CAUTION. DO NOT LET THE CORE FLY OUT.**

6. Once the tire is deflated, place the bead breaker shoe over the tire and up to the edge of the rim. Press the right-hand pedal and break both the upper and lower beads. Press down by hand on the left side of the tire to break the top bead completely. Set the bead breaker aside so it won't be in the way during the next steps.



7. Lubricate the top tire bead and upper rim edge.

8. Hook the flat end of the tire iron under the upper bead and pry the bead over the rim. Lock the slot of the tire iron over the centre post key of the tire changer.

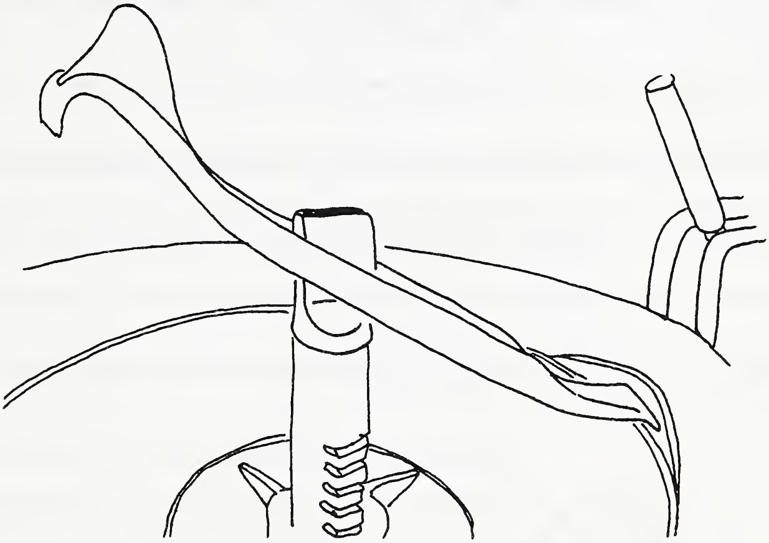


9. Dismount the top bead by pressing the right-hand pedal and rotating the tire iron.

10. Unhook the tire iron from the centre post key before releasing the pedal.

11. Place the flat end of the tire iron under the lower bead and pry the bead over the rim.

12. Lock the slot of the tire iron over the centre shaft of the tire changer.



13. Dismount the lower bead by pressing the right-hand pedal and rotating the tire iron.

14. Remove the tire iron and return it to the storage slot.

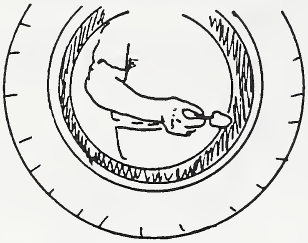
15. The tire is now off the rim and ready for repair or replacement.

16. Inspect the rim and tire for damage or other problems.

    Note: Many automotive repair businesses have a policy of changing the valve stem at this point of tire service.

Installation

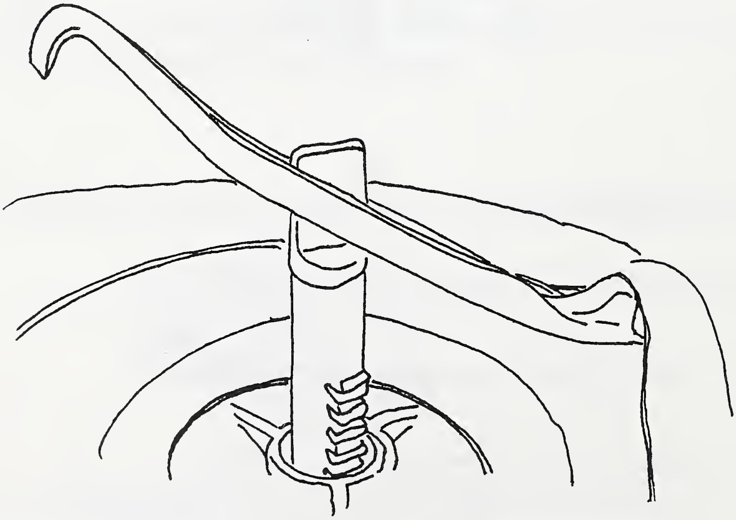
1. Stand the tire on the rim. Dip the brush into the container of rubber lubricant. Swab the inside of both bead surfaces.



Note: The lubricant will help the tire slide over the rim and prevent damage to the tire.

2. By hand, turn the tire to partially mount the lower bead over at least half of the upper rim flange.

3. Slide the hooked end of the tire iron against the lower bead and rim contact area.



4. Slowly press the right-hand pedal while applying pressure against the tire iron. The centre post will turn and the tire iron slot will drop over the key. Continue pressing the pedal and let the tire iron slide the bead into place.

   Note: The tire bead must slide down into the dropped centre portion of the rim. If it does not, the tire will jam onto the rim.

5. Repeat the process for the top bead.

6. Once the tire is completely on, hook the inflator hose to the valve stem.

7. Spin and raise the tire so that the tire beads are seated on the top rim flange.

8. While holding the tire up onto the top rim flange, press HARD and QUICKLY on the left pedal. This will send a blast of air into the tire and seat the bottom bead automatically.

9. Once both beads have started to seat, release the left pedal slightly and continue filling the tire with air.

CAUTION

- Never use more than 275 kpa (40 psi) to seat the tire bead.
- As soon as the beads have seated, loosen the tire rim tightening collar.
- Do not position your hands or face anywhere over the tire while inflating.

10. After the beads have seated, remove the inflator hose and install the valve core using the valve core tool. Inflate the tire to the specified inflation pressure.

11. Remove the tire from the tire machine.

    Note: The tire is now ready to be balanced or retested for leaks.

12. Clean and return all equipment, tools and supplies to their proper storage areas.

13. Clean up the work area.

TIRE BALANCING

Tire balancing is the task of adding lead weights to a rim edge to counteract heavy spots. A balanced tire is one that can be rapidly spun without any shaking. Shaking may be caused by heavy spots on the tire or rim. Tires that are not properly balanced will tend to vibrate, wear badly at heavy spots and cause cup-shaped depressions in the tread.

Two types of wheel balancing procedures are used to cure tire imbalance problems.

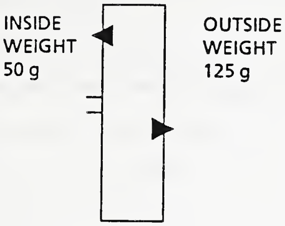
- Static Balancing
- Dynamic Balancing

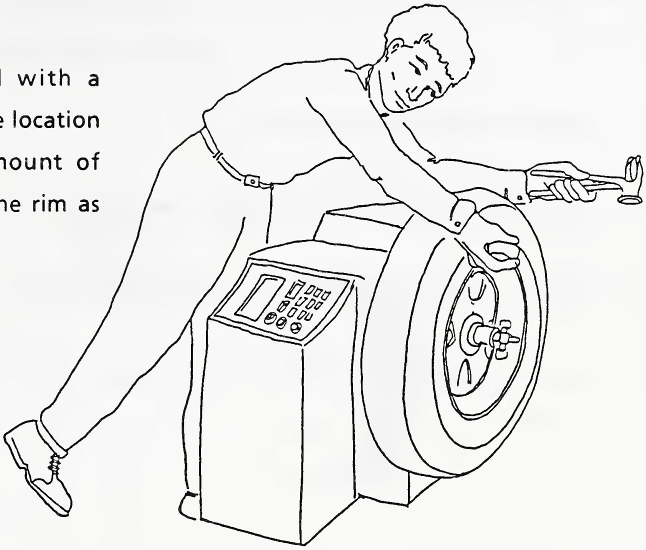
Static Balancing Procedure

Place the tire on a bubble balancer in a horizontal position. The balancer is like a teeter-totter so the heaviest side of the tire will tilt downward. Lead wheel weights are added to the high side of the rim until the tire sits level. Because the tire is not in motion, static balancing is not considered as accurate as dynamic balancing.

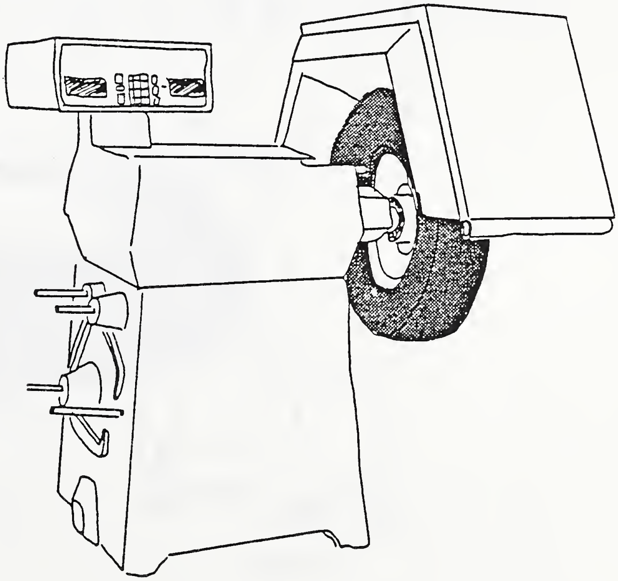
Dynamic Balancing Procedure

This popular procedure is performed with a machine that spins the tire, determines the location of the imbalance and measures the amount of imbalance. Lead weights are added to the rim as indicated by the machine.





- Off the Car Balancer. This machine requires that the tire be removed and mounted for spinning and measurement. Because of their speed, ease of use and accuracy, these have become the most common form of wheel balancing machines in the industry today.



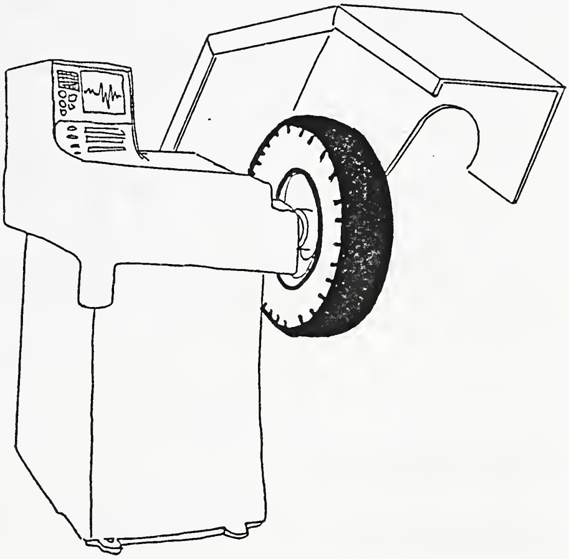
In order to achieve quality service, each of the following procedures must be observed during a wheel balance.

- Check and adjust all tire pressures.
- Locate and repair any tire leaks before balancing.
- Remove mud and rocks from the tire before balancing.
- Securely install wheel weights on the rim edge. Once installed, weights should not be moveable by hand.

JOB SHEET 25
BALANCING TIRES

EQUIPMENT, TOOLS AND SUPPLIES

- Eye protection
- Dynamic off the car balancer
- Pressure washer
- Tire pressure gauge
- Wheel weight pliers
- Wheel weight assortment
- Tire and rim assembly



PROCEDURE

Note 1: Safety glasses are required throughout this operation.

Note 2: The teacher/supervisor's demonstration must be observed before attempting this task.

1. Wash the tire and rim assembly.

2. Notify the teacher/supervisor if any tire leaks or damage are noticed.

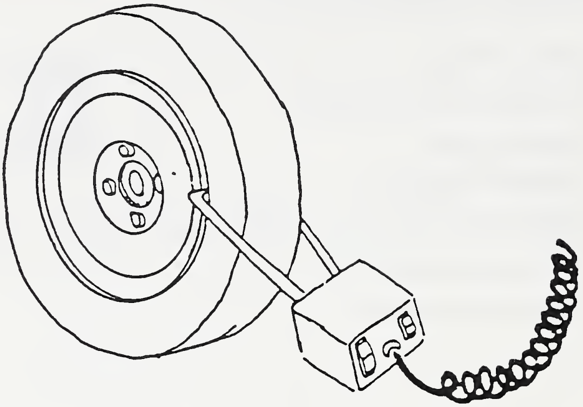
3. Remove all rocks from the tire tread.

4. Remove all old wheel weights from the rim.

5. Check and adjust the tire inflation to specifications.

6. Mount the tire securely on the machine.

7. Measure the tire according to directions given in the operator's manual or by the teacher/supervisor.



8. Close the safety shield.

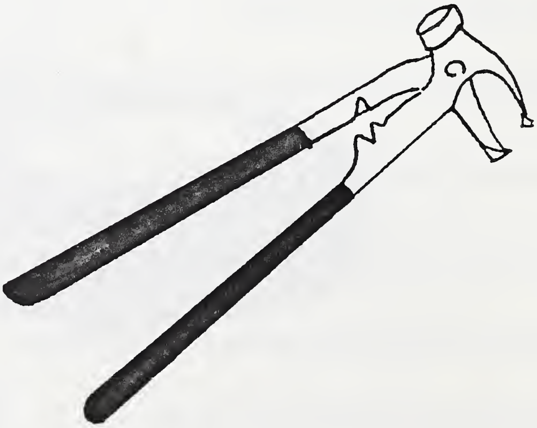
9. Spin the tire.

CAUTION: Shut down the machine immediately if the wheel starts to make a ringing noise.

10. Wait for the tire to stop turning.

11. Raise the safety shield.

12. Install the required wheel weights at the positions indicated on the machine display.



13. Close the safety shield.

14. Spin the tire to recheck the tire balance. Rebalance as necessary.

15. Wait for the tire to stop spinning.

16. Remove the tire from the machine.

17. Put away the tire and rim in their proper storage areas.

18. Clean and return all equipment, tools and supplies to their proper storage areas.

19. Clean up the work area.

20. Record the following information.

- Amount of old weights removed Inside ____________ Outside ____________
- Original tire pressure ________________
- Specified tire pressure ________________
- Amount of new weights installed Inside ____________ Outside ____________

REPAIRING TIRE LEAKS

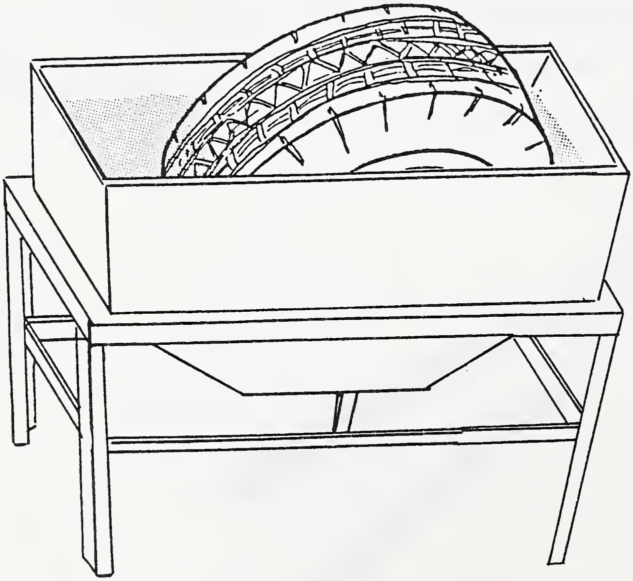
Tire repair involves finding the leaks and repairing the problem.

Finding Tire Leaks

When repairing tire leaks, the leak must be located before dismounting the tire. A tire can leak in several places:

- around a foreign object (e.g., nail)
- from a puncture hole
- through or past the valve stem
- anywhere around the rim where the tire sits.

By inflating the tire and placing the wheel assembly into a tank of water, the leak is pinpointed by air bubbles.



JOB SHEET 26

FINDING A TIRE LEAK

EQUIPMENT, TOOLS AND SUPPLIES

- Tire with a leak
- Tire water tank
- Tire chalk or crayon
- Rag

PROCEDURE

1. Place the inflated tire into the tire water tank. The water should completely cover the bottom portion of the tire.

2. Watch for air bubbles coming up through the water. Rotate the tire slowly and locate the source of the bubbles.

3. Rotate the tire so that the hole is out of the water.

4. Wipe the area with the rag and mark the hole with the tire crayon.

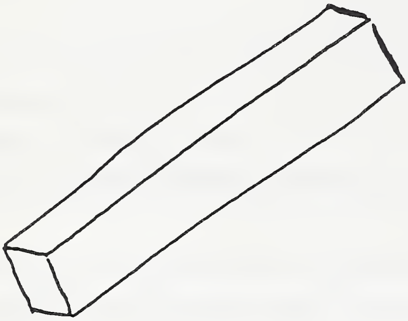
5. Clean and return all equipment, tools and supplies to their proper storage areas.

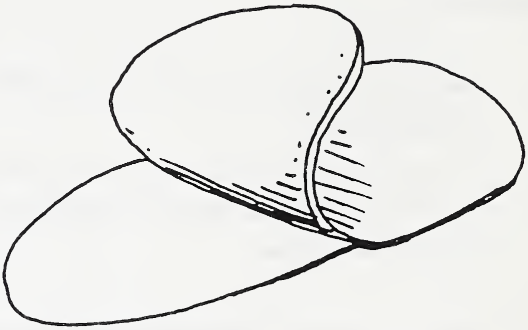
6. Clean up the work area.

Repairing Tire Leaks

Although modern radial tires are almost puncture proof, it is still sometimes necessary to repair holes in them. There are two methods available to the tire service person:

- a tire plug
- a patch inside the tire.





Of these two methods, the patch is preferred since it does not damage the tire plies. A plug can sometimes do harm to the tire. The patch does, however, require the removal of the tire from the rim for repair.

Before repairing the tire, check for internal damage. Driving a car with a flat tire for more than a very short distance will ruin the tire.

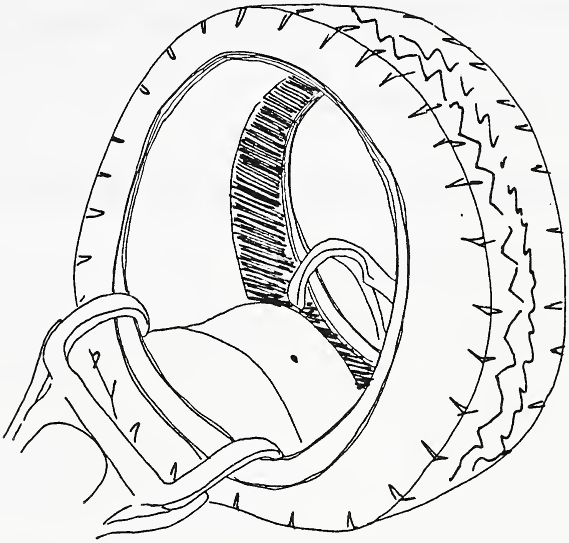
Replace the tire if:

- the tire has cracks or tears along the sidewalls, or if the inside of the tire looks ripped and frayed
- the tire is almost worn out
- the puncture is within 6 mm of the sidewall or on the sidewall.

JOB SHEET 27
PATCHING A TIRE

EQUIPMENT, TOOLS AND SUPPLIES

- Eye protection
- Vacuum cleaner
- Tire bead expander
- Tire buffer
- Tire tank
- Patch and vulcanizing cement
- Patch stitcher
- Tire with a leak in it



PROCEDURE

1. Put on the eye protection.

2. Locate and mark the tire leak.

3. Remove the tire from the rim.

4. Mount the tire in the bead expander so that the puncture is at the bottom of the tire.

5. Pull the beads apart.

6. Buff the area around the hole on the inside of the tire. Make the buffed area about 10 mm larger in diameter than the tire patch.
   Note: Be careful not to buff too deeply, otherwise you could damage the tire.

7. Vacuum the shavings out of the tire.

8. Paint some vulcanizing cement onto the buffed area and follow the drying directions on the container.

9. Once the cement has set, peel and place the patch on the cement.
   Note: Avoid wrinkles when applying the patch.

10. Stitch the patch firmly in place with the patch stitcher. Roll the stitcher over the patch in all directions until the plastic cover loosens.

    Note: If the patch isn't stitched down properly it will fall off and the tire will leak again.

11. Remount the tire and inflate it to specifications.

12. Retest the tire for leaks.

13. Clean and return all equipment, tools and supplies to their proper storage areas.

14. Clean up the work area.

WORK STANDARDS AND MANAGEMENT

The major tasks of employees in any industry are to provide quality service and maintain positive relationships with clients and fellow employees. To achieve these goals, every supervisor expects certain standards to be met. These standards include:

1. **Personal Standards**
    - Is punctual
    - Shows initiative
    - Practises personal hygiene
    - Is well groomed
    - Is self-directed
    - Remains on task
    - Demonstrates an acceptable level of accuracy

2. **Regulatory Standards**
    - Knows and follows safety regulations
    - Maintains safe work area

3. **Materials-Use Standards**
    - Demonstrates safe-use practices
    - Cares for and maintains equipment and tools
    - Uses supplies with care

4. **Interpersonal Standards**
    - Demonstrates respect for property
    - Shows respect for others
    - Has a positive attitude to work
    - Has a pleasant personality

Throughout the course you will be evaluated on how well you are meeting these standards.

To help identify the standards expected during this course, evaluate yourself using Appendix 2: Work Standards and Management Monthly Evaluation Chart.

At the end of each month, make a copy of the chart and evaluate your performance. Check previous evaluations and note the improvements.

AUTOMOTIVE SERVICES 16 PROFILE

JOB SCOPE	1 Identifies automotive service careers	2 Describes the job duties in an automotive service career	3 Identifies related careers	4 Describes the job duties in a related career
	5 Defines common terms used in the automotive service industry	6 Identifies features of an automotive shop		
EQUIPMENT AND TOOL IDENTIFICATION	1 Identifies common automotive service equipment	2 Identifies common tools	3 Identifies suitable equipment and tools required for assigned tasks	4 Identifies storage areas and methods used for equipment and tools
SUPPLIES IDENTIFICATION	1 Identifies common automotive supplies	2 Identifies the uses for a variety of supplies	3 Identifies different types of lubricants	4 Reads lubricant information labels
	5 Identifies the service and viscosity rating of an oil	6 Selects the correct fluids for a vehicle		
VEHICLE PARTS IDENTIFICATION	1 Interprets VIN to identify vehicle components	2 Identifies major components of a vehicle	3 Identifies systems of a vehicle	
AUTOMOTIVE ENGINES	1 Defines the term "internal combustion"	2 Identifies major components of an engine	3 Describes the operation of the 4-stroke cycle engine	4 Identifies engine support systems
EQUIPMENT AND TOOL USE	1 Demonstrates the ability to select suitable equipment and tools for tasks	2 Uses basic equipment and tools to complete tasks	3 Demonstrates safe handling practices	4 Uses all required safety equipment and tools for tasks
	5 Cleans and returns equipment and tools after use			

AUTOMOTIVE SERVICES 16
PROFILE (continued)

VEHICLE CLEANING	1 Identifies the reasons for maintaining a clean vehicle	2 Cleans a vehicle's interior and exterior	3	
BASIC AUTOMOTIVE MAINTENANCE	1 Changes engine oil and oil filter	2 Checks and adjusts fluid levels	3 Tests coolant	4 Adjusts or replaces fan belts
	5 Replaces coolant hoses	6 Adjusts tire pressure	7 Removes and replaces tires on rims	8 Repairs tire leaks
	9 Balances tire assemblies	10 Performs simple diagnostics on vehicle		
WORK STANDARDS	1 Identifies the reasons for standards	2 Identifies common automotive industry safety standards	3 Performs to standards set by teacher/supervisor	4 Evaluates own performance to standards
SUPPLY MANAGEMENT	1 Identifies ways of controlling supply management	2 Uses supplies efficiently and effectively		
WORK AREA MANAGEMENT	1 Identifies procedures used to maintain a safe, clean work area	2 Maintains a safe, clean work area	3 Cleans up work area when tasks completed	

WORK STANDARDS AND MANAGEMENT MONTHLY EVALUATION CHART

Name ____________________ Date ____________________	Evaluation	
	Satisfactory	Unsatisfactory
DEMONSTRATES APPROPRIATE WORK HABITS		
Is punctual		
Comes prepared to work		
Prepares immediately for work		
Performs duties as instructed, with acceptable accuracy		
Uses time productively		
Considers solutions to problems before asking for assistance		
FOLLOWS RULES AND REGULATIONS		
Follows acceptable safety and sanitation procedures		
Does not bring food or drink into the work area		
Dresses appropriately		
Uses equipment, tools and supplies as instructed		
Clears work area after use		
Performs required clean-up duties		
DEMONSTRATES CONCERN FOR SAFETY		
Demonstrates safety practices		
Maintains a safe and sanitary work area		
Wipes up spills immediately		
Does not leave work area without permission		
DEMONSTRATES PROFESSIONAL ATTITUDE		
Displays a professional appearance		
Is friendly and courteous		
Advises teacher/supervisor of hazards or necessary repairs		
Informs teacher/supervisor in advance of necessary absences		
Demonstrates responsibility for completion of assignments and tasks		
Follows verbal and written instructions		
Demonstrates an organized work approach		

Areas to improve next month are:

____

JOB SHEET EVALUATION RECORD

JOB SHEET	EVALUATION								
	Self			Classmate			Teacher/Supervisor		
	1	2	3	1	2	3	1	2	3
1. Testing with a Torque Wrench									
2. Drawing a Shop Map									
3. Making a Hoist Diagram									
4. Using a Hoist									
5. Making a Floor Jack Diagram									
6. Selecting Floor Jack Lifting Points									
7. Using a Floor Jack									
8. Washing a Vehicle									
9. Describing Cap Screws									
10. Identifying Fasteners									
11. Identifying Major Parts of Vehicles									
12. Interpreting Vehicle Identification Numbers									
13. Identifying Engine Parts									
14. Changing Engine Oil and Filter									
15. Lubricating a Chassis									
16. Checking the Standard Transmission Oil Level									
17. Checking the ATF Level									
18. Checking the Rear Axle Assembly Oil Level									

JOB SHEET	EVALUATION								
	Self			Classmate			Teacher/Supervisor		
	1	2	3	1	2	3	1	2	3
19. Adjusting a Fan Belt									
20. Replacing a Fan Belt									
21. Testing Antifreeze Strength									
22. Replacing an Upper Radiator Hose									
23. Adjusting Tire Pressure									
24. Changing Tires									
25. Balancing Tires									
26. Finding a Tire Leak									
27. Patching a Tire									

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